HANDBOOKS OF AMERICAN NATURAL HISTORY

ALBERT HAZEN WRIGHT, ADVISORY EDITOR

HANDBOOK OF LIZARDS

HOBART M. SMITH

WITH PHOTOGRAPHS BY

ALBERT HAZEN WRIGHT

Handbook of
LIZARDS

LIZARDS OF THE UNITED STATES AND OF CANADA

BY HOBART M. SMITH

Professor of Zoology, University of Illinois

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TO EDWARD H. TAYLOR

Who marked a rugged path and shared with me the thrills of countless new horizons.

PREFACE

THIS BOOK is intended for anyone interested in North American lizards, both the casual student of natural history and the amateur herpetologist. It is a summary that has been wanting for several years since no other single source of general information on lizards of this area has been available. Ditmars' very popular work, *The Reptiles of North America*, does not treat lizards in the detail desirable for the amateur, and, moreover, it is already (since 1936) out of date in many nomenclatorial respects. The only other summary of anything like recent date is Burt's *Key to the Lizards of the United States and Canada* (1936). While very useful, as its title states this work is simply a key, with brief statements of ranges; descriptions and discussions of individual species are lacking. Nevertheless this is the most authentic summary of lizards that has appeared in recent years, and, because of its conservativeness, ranks as an excellent foundation for further contributions. Unauthoritative but useful keys are to be found in Pratt's *Manual of the Land and Fresh Water Vertebrate Animals of the United States* (1923); of similar but less accurate nature, although with more recent nomenclature, is Driver's *Name that Animal* (1942). The well-known *Check List of North American Amphibians and Reptiles* (1943) by Stejneger and Barbour is of course a standard reference work for lists of species and gives the range, type locality, and a brief synonymy for each form.

The area covered herein is the United States and Canada. Baja California is excluded from consideration. The species treated include all native forms recorded from this area, all the reported exotic species that have become established at least for the time being, and a few species that have never been authentically reported in the area but possibly occur.

The scientific names are those which, to the best of my knowledge, are required by present and impending rules and recommendations of zoological nomenclature. Complete stability of the names used is not to be expected, for the lizards of this area are so incompletely known that many rearrangements will result from further studies. From the current standard check list of reptiles and amphibians by Stejneger and Barbour, the following deviations occur (the fórm adopted here is given last):

Hemidactylus turcicus = *Hemidactylus turcicus turcicus.*
Holbrookia elegans = *Holbrookia maculata thermophila.*
Holbrookia lacerata = *Holbrookia maculata lacerata.*
Add *Holbrookia maculata ruthveni.*
Holbrookia propinqua propinqua and *Holbrookia propinqua stonei* = *Holbrookia propinqua.*
Holbrookia pulchra = *Holbrookia maculata pulchra.*
Callisaurus ventralis ventralis = *Callisaurus draconoides ventralis.*
Crotaphytus silus = *Gambelia wislizenii silus.*
Crotaphytus wislizenii = *Gambelia wislizenii wislizenii.*
Sceloporus couchii omitted here as a very improbable resident of the United States.
Sceloporus disparilis = *Sceloporus grammicus disparilis.*
Sceloporus floridanus and *Sceloporus spinosus* = *Sceloporus olivaceus.*
Sceloporus jarrovii = *Sceloporus jarrovii jarrovii.*
Sceloporus magister = *Sceloporus magister magister.*
Sceloporus undulatus fasciatus = *Sceloporus undulatus hyacinthinus.*
Add *Sceloporus undulatus tristichus.*
Add *Sceloporus undulatus undulatus.*
Add *Sceloporus undulatus virgatus.*
Urosaurus ornatus graciosus = *Urosaurus graciosus.*
Phrynosoma blainvillii blainvillii = *Phrynosoma coronatum blainvillii.*
Phrynosoma blainvillii frontale = *Phrynosoma coronatum frontale.*
Phrynosoma brevirostre = *Phrynosoma douglassii brevirostre.*
Phrynosoma orbiculare douglassii = *Phrynosoma douglassii douglassii.*
Phrynosoma orbiculare hernandesi = *Phrynosoma douglassii hernandesi.*
Phrynosoma orbiculare ornatissimum = *Phrynosoma douglassii ornatissimum.*
Phrynosoma orbiculare ornatum = *Phrynosoma douglassii ornatum.*
Leiolopisma unicolor = *Leiolopisma laterale.*
Eumeces humilis = *Eumeces taylori.*
Eumeces gilberti rubricaudatus = *Eumeces rubricaudatus.*
Eumeces skiltonianus brevipes = *Eumeces gilberti placerensis.*
Add *Lacerta melissellensis fiumana.*
Cnemidophorus gularis = *Cnemidophorus gularis gularis.*
Cnemidophorus hyperythrus hyperythrus (part) = *Cnemidophorus hyperythrus beldingi.*
Cnemidophorus perplexus = *Cnemidophorus gularis octolineatus.*
Add *Cnemidophorus perplexus.*
Add *Cnemidophorus tesselatus aethiops.*
Add *Bipes* sp.
Gerrhonotus imbricatus levicollis = *Gerrhonotus levicollis levicollis.*
Gerrhonotus infernalis = *Gerrhonotus liocephalus infernalis.*

The common names are those currently in use, or that I believe appropriate. I have tried to follow Netting's precepts in choosing these names:

> If standardization is to be achieved the name which is most appropriate for a particular species, or the name which is in widest use throughout the range of the form, should be given preference over one which is of local application only. Certain names which impart false taxonomic position (Congo eel) or which imply inaccuracies of structures, markings, or ranges must be ruthlessly discarded. In general, names descriptive of the animal, its habitat or its behavior should be given preference, geographic names second preference, and patronymics should be used only as a last resort (Bragg, *lit. cit.*).

Use of this book requires no special directions except for perhaps two points. The keys for identifying specimens begin on p. 60. The family is determined by starting at number 1 and deciding which of the two contrasting statements is true; the one selected as best fitting the specimen being identified refers the reader to the number of another pair of opposing characters. Finding the couplet of the corresponding number, the reader will again decide which of the two contrasts is correct. This procedure is to be continued until a name, instead of a number, is cited at the right side of the page. This is the family name. On the page upon which the treatment of this family begins, another set of keys will be found, which will supply the generic name; at the beginning of each generic discussion will be found the species keys.

The bibliography is listed in three sections: "General Literature," "Literature Cited," and "State Lists of Species and Literature." In Part I and in the descriptions of families and genera, each reference to other books and articles gives the author, sometimes the page, and the list in which the article will be found cited in full. The year is also included if more than one article by an author is found in the list specified. For articles in "General Literature," the abbreviation *gen. lit.* is used; those in the "Literature Cited" lists are indicated by *lit. cit.;* and those listed in the state bibliographies are indicated by an abbreviation in italics of the name of the state under which the reference can be found. In the descriptions of species, bibliographical section references for the authors referred to in the text and not otherwise identified will be found at the end under the heading "References."

Definitions of terms and explanations of methods of making various scale counts and taking measurements will be found under the heading "Descriptive Terminology," where they are arranged in anatomical sequence. Page references for them are given in the index.

The kindly assistance and co-operation of many individuals and institutions have been essential to the completion of this book. The authorities of the Museum of Zoology of the University of Michigan, of the Chicago Natural History Museum, and of the University of Rochester, by making their collections available for study, have been of immeasurable service. I am further in-

debted to the University of Rochester, through the good offices of Dr. Curt Stern, for financial aid in numerous respects. My associates at that institution, especially Dr. Sherman C. Bishop and Dr. Joseph Tihen, who have frequently been consulted, have my gratitude for particularly valued suggestions. Dr. Edward H. Taylor, as always, has been a source of inspiration as well as of more concrete contributions that have been of great aid.

The photographs are, for the most part, products of the painstaking efforts over many years of Dr. Albert Hazen Wright and his close collaborator, Mrs. Anna Allen Wright. Unless otherwise specified the photographs are from them. The completion before I started on the text of a series of photographs, which illustrated practically all United States lizards, was a tremendous and invaluable advantage; the work undoubtedly would not have been undertaken without it. Mr. Arthur Smith of Cornell University and Mr. Ray Maas of the University of Rochester have my sincere gratitude for their labors in the long task of making prints from some of Dr. Wright's negatives, and for several original photographs.

Certain other photographs (66) were contributed by the U.S. Fish and Wildlife Service, through the courtesy of Dr. F. M. Uhler, who very generously offered the use of some two hundred superb portraits. Still others (18) are included through the courtesy of Dr. Howard K. Gloyd, whose artistry in photography shows no limitation to his special subject of snakes. Dr. Edward H. Taylor very kindly contributed thirty-one original prints reproduced in his work on *Eumeces*. Mr. Arthur Smith and Mr. Robert McCauley of Cornell University generously contributed sixteen prints. Dr. Joseph R. Slevin very kindly permitted the use of seven excellent portraits. The X rays (2) were contributed through the courtesy of Mr. Charles C. Leake of Prescott, Arizona. The New York Zoological Society, through the kindness of Mr. William Bridges, generously presented the two photographs of *Phrynosoma ditmarsi*. All illustrations from sources other than the files of Dr. Wright are indicated where they occur in the book. In all cases of duplication from the several sources of pictures of the same species (and there have been many) I have chosen Dr. Wright's unless others possessed unusual merit.

The photographs of Dr. John Van Denburgh and Dr. Joseph R. Slevin were very generously made available by Miss Sarah Atsatt; that of Dr. Raymond L. Ditmars (a Hal Phyfe photograph) by his daughter, Miss Gladyce M. Ditmars; of Dr. Henry S. Fitch by Mr. Chester Fitch; of Dr. Edward H. Taylor by Dr. A. B. Leonard. That of Miss Mary C. Dickerson is from *Natural History*, by courtesy of the American Museum of Natural History. Portraits of the other herpetologists were made available individually by them (that of Dr. C. L. Camp is by Dr. Lawrence Compton). To all these individuals I am very grateful.

Many of the figures have been reproduced from Cope's famous monograph, *The Crocodilians, Lizards and Snakes of North America* (1900), and from

Burt's key to North American lizards; still others have been culled from a miscellaneous lot of papers of lesser scope. Due acknowledgment is given all authors where the figure is reproduced. The copy work and a few original drawings are the work of Misses Jean Adolph and Patricia Walker of the University of Rochester.

Finally I wish to express my profound appreciation for the complete and generous co-operation of the editorial staff of the Comstock Publishing Company, especially Miss Catherine Sturtevant, who deserves much for her very careful editing of the manuscript.

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Hobart M. Smith

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PART I

INTRODUCTION

ZOOLOGICAL POSITION

LIZARDS belong to the class Reptilia, of the subphylum Vertebrata, of the phylum Chordata, of the animal kingdom. Like other reptiles they are covered with a generally scaly skin devoid of sweat and oil glands, are adapted to living their entire lives on land (some species have secondarily reverted to an aquatic habitat), and lack a means of independently maintaining a constant temperature (i.e., they are "cold-blooded"). There are many internal characteristics that need not be listed here. The features mentioned are among the chief characteristics of the reptiles, however. Of the other major vertebrate groups, fishes and amphibians with few exceptions must pass a part of their lives in water, and even those few exceptions are very dependent at some stage upon a high humidity; and birds and mammals are capable of independently maintaining a constant temperature (i.e., they are "warm-blooded") and are provided with either feathers or hair, both of which are lacking in reptiles.

Reptiles are generally thought of as a decadent group which reached its maximum development and domination of the world far in the past. This is true of reptiles as a whole, but not so distinctly of the order to which lizards belong. That order is probably but little less diverse now than it ever has been. It is a rather ancient order, the oldest genus being known from the Triassic period, but not until the Cretaceous did many genera and species become known.

CHARACTERISTICS

Four main groups of reptiles are extant in the world today: the turtles, the crocodiles, a peculiar lizardlike animal known as the tuatara (*Sphenodon*), and, as one group, the snakes and lizards. The last group is known as the order Squamata; the snakes as the suborder Serpentes, the lizards as the suborder Sauria (or Lacertilia).

The saurians are distinguished by having at least vestiges (internal) of pectoral and pelvic girdles; a transverse anal opening; paired copulatory organs; a cloacal bladder; the brain case at least partially open anteriorly; and the two halves of the lower jaw united in a fixed, immovable suture. As a general rule the eyes have lids, the tongue is short and thick, a functional ear

is present, and the limbs are well developed; but even in our American lizards there are exceptions.

Limbless lizards may look much like snakes, which are in fact closely related to, and probably derived from, the Sauria. Snakes differ from lizards in always lacking a pectoral girdle (with perhaps a few very recently discovered exceptions), and in having the two halves of the lower jaw united by a ligament and thus movable. In addition no movable eyelids are present, no locomotorily functional limbs are present, the brain case is closed anteriorly, the ear is useless, and the tongue is elongate and retractile into a sheath. Without reference to internal anatomy, however, there is no infallible rule whereby lizards and snakes can be distinguished. There are two interesting differences in habits: lizards usually eat their food with some slight attempt at mastication, and they drink by lapping with the tongue. Snakes, on the other hand, never chew their food, and they drink by sucking water into the mouth between the lips. In general snakes also shed their "skins" entire, while lizards shed in sections.

Next to snakes, the animals most frequently confused with lizards are salamanders, members of the class Amphibia. These can be distinguished by their smooth, scaleless, usually somewhat slimy skin, and the presence of no more than four digits on the front feet. Although similar in form, they are not so closely related to lizards as are the usually more strikingly different snakes.

Some lizards, of the limbless, burrowing types, have no doubt been passed by many casual observers as worms. Any sort of close examination would reveal a mouth closed by a hinged jaw—something no worm possesses. Yet one should not be ashamed if fooled momentarily once or twice; the best of herpetologists are his company.

DISTRIBUTION

Saurians are known from practically all the warmer parts of the world. In the Western Hemisphere they range from southern Canada to Tierra del Fuego and are found in the West Indies and the oceanic islands. In the Eastern Hemisphere they are known from extreme southern Siberia, southern Kamchatka Peninsula, and near the Arctic Circle in Finland and Sweden, southward through Africa, Australia, and Tasmania. Practically every Pacific island is provided with one or more species of lizards, either derived from earlier direct connections with the continents or from accidental dispersal, much of the latter depending upon human activities. Lizards are, in fact, among the most easily dispersed of all vertebrates; they are excelled in this respect only by s[illegible] birds and mammals.

MAJOR GROUPS

According t[illegible]oritative estimate some three thousand species and subspecies of lizards [illegible] known throughout the world. This is about the same

number as of snakes, but greatly exceeds the number of kinds of other reptiles. Next to the Amphibia, this is the least abundant, in species, of all classes of jawed vertebrates.

Some three hundred genera are included in the lizards, and these in turn are grouped into about twenty families. Several other families and genera are known from fossils only. Nine families occur in the United States. Although many species are restricted to this country, no family is so limited. It may be mentioned however that the Anniellidae extends only a short distance beyond our borders.

The families are as follows:

1. GEKKONIDAE. Includes the families Eublepharidae and Uroplatidae of the older authors (cf. Malcolm Smith, 1933, *lit. cit.*). (See discussion.)
2. IGUANIDAE. (See discussion.)
3. AGAMIDAE. A sort of Old World duplicate of the Iguanidae.
4. CHAMAELEONIDAE. The true chameleons, found in Africa, Madagascar, and India.
5. XANTUSIIDAE. (See discussion.)
6. SCINCIDAE. (See discussion.)
7. ANELYTROPSIDAE. A peculiar burrowing, limbless, very rare family of one species, restricted to Mexico.
8. FEYLINIIDAE. Rather like the preceding, restricted to Africa.
9. DIBAMIDAE. Similar to the preceding two, except that the males have flaplike hind limbs; restricted to New Guinea and some adjacent islands
10. GERRHOSAURIDAE. Limbs variable, sometimes reduced to stumps. Madagascar and Africa.
11. LACERTIDAE. (See discussion.)
12. TEIIDAE. (See discussion.)
13. AMPHISBAENIDAE. (See discussion.)
14. VARANIDAE. Large lizards, including *Varanus komodoensis*, the largest of all living lizards. Africa, Arabia, southern Asia, and Australia.
15. PYGOPODIDAE. Snakelike lizards with scalelike hind limbs and no external forelegs. Australia and New Guinea.
16. HELODERMIDAE. (See discussion.)
17. ANGUIDAE. (See discussion.)
18. XENOSAURIDAE. Only one species, restricted to Mexico, flattened, secretive.
19. ANNIELLIDAE. (See discussion.)
20. CORDYLIDAE. Africa and Madagascar. Formerly called Zonuridae.

For the United States 136 species are listed here, but 6 are imported species not native to this country,[1] and 3 others, although possibly occurring, have not yet been recorded for this country.[2] Accordingly but 127 endemic species are

[1] *Gonatodes fuscus, Hemidactylus t. turcicus, Sphaerodactylus cinereus, S. notatus, Leiocephalus carinatus virescens, Lacerta melissellensis fiumana.*

[2] *Ctenosaura hemilopha, Bipes* sp., and *Gerrhonotus l. levicollis.*

known from the United States and Canada. These represent 9 families and 25 genera. While several genera contain only one form in the area covered, only one (*Neoseps*) is actually monotypic.

FOSSIL HISTORY

The suborder of lizards is known to have existed as early as the Triassic, from which era one genus (*Paliguana*), long subject to considerable debate on its lacertilian affinities, is known from Africa.

In North America the earliest occurrence of bona fide lizards was in the Upper Cretaceous, from which period numerous typical lizards are known. The suborder is not represented in the Lower Cretaceous in North America. In the earliest period of their appearance, however, the group seems to have had an amazing variety of forms. Three living families (Anguidae, Iguanidae, Varanidae) and one extinct family (Polyglyphanodontidae) are among those known, while other families are probably represented by the many genera not allocated to a family.

The Anguidae was present in most other later periods, but none of the modern genera are known as fossils. The Iguanidae likewise was well represented by various extinct genera, and modern genera occurred in the Pliocene (*Crotaphytus*) and Pleistocene (*Phrynosoma*). A genus perhaps ancestral to *Phrynosoma,* however, existed as early as the Upper Cretaceous (*Exostinus*). The Varanidae does not occur in the Americas today; it disappears from the fossil record in the Oligocene.

In the Paleocene no new families appeared, although a number of genera are not allocated to any family. In the Eocene, however, the Amphisbaenidae made its first appearance, and another family not now present in North America, the Chameleonidae, was also represented. This is the only known period of occurrence of the latter family in this hemisphere. In the Oligocene for the first time modern genera were present, including *Heloderma* (the first appearance of its family) and *Rhineura* of the Amphisbaenidae. The species, of course, are extinct. Other modern genera occurred in the Pliocene (*Crotaphytus, Cnemidophorus,* and *Eumeces*) and in the Pleistocene (*Phrynosoma*). A few extinct genera are known from these two periods and from the Miocene, but all are referable to families now occurring in North America. The fossil history of the Geckonidae, Xantusiidae, and Anniellidae is completely unknown in this hemisphere.

Many of the fossil lizards were larger than any species now living in North America, although not approaching the size of the large living varanids of Asia, which reach a length of some 12 to 14 feet. The largest fossil species of North America appears to be an anguid (*Glyptosaurus giganteus*), the bulky lower jaw of which probably measured some 7 inches in length.

Among the most curious of fossil lizards are the members of the family

Polyglyphanodontidae, in which the teeth are compressed anteroposteriorly instead of laterally (Gilmore, 1942, *lit. cit.*).

Gilmore's monograph (1928, *gen. lit.*) on North American fossil lizards will be found an invaluable source of further information on this topic.

The large marine lizards (mosasaurs) have not been mentioned in the preceding summary, although they belong to a family (Mosasauridae) showing a very close relationship to the Varanidae and are placed in the same subdivision of the Sauria (or Lacertilia) as the latter family. The mosasaurs, however, like their European relatives, the aigialosaurs and dolichosaurs, were highly specialized marine creatures; the specialization was so marked that mosasaurs are commonly regarded as something distinct from lizards, even by specialists. The close relationship of these marine animals, which are known only from fossils, to other lizards must, however, be kept in mind. They existed in the Lower and Upper Cretaceous, and add another group to that extremely varied assemblage of lacertilians which we know existed during Cretaceous times.

STRUCTURE

There are many general works in which the anatomy of lizards is treated in some detail. Among the more general of these sources are Gadow's *Amphibia and Reptiles* (*gen. lit.*), Cope's *Crocodilians, Lizards and Snakes of North America* (*gen. lit.*), and Parker and Haswell's *Textbook of Zoology* (*lit. cit.*). References to many important anatomical works may be found in Hyman's *Comparative Vertebrate Anatomy* (*lit. cit.*). To these the reader is referred for information on many features that cannot be mentioned here. Only topics of general interest have been selected for discussion in the following pages.

SKIN

The external covering of all lizards consists of a dry skin formed into regular or irregular protuberances called scales. The scales involve both epidermis and dermis. When the loose epidermis (popularly but incorrectly called the "skin") is shed, or when it is rubbed off long-preserved animals, the scale form still remains. Cornifications of the epidermis produce most of the spines and rugosities of a lizard scale; this is demonstrated by removing the loose part from some dorsal scale of a spinose lizard like the fence lizard, for then scarcely any evidence of spines or other roughness remains.

Moulting (ecdysis or exuviation) of the epidermis occurs at more or less regular intervals throughout the part of the year in which the animals are active. The length of the intervals varies with the species; geckos tend to shed rather frequently (about twice a month), other lizards a little less often (once every 30 to 45 days). Rapidity of growth may affect the frequency of moult-

ing. Shedding may therefore be expected at more frequent intervals in young than in adult specimens, since growth is exceedingly rapid until the adult size is reached. Other factors, such as food supply, temperature, and moisture, are known to have a direct effect upon the regularity of exuviation. Under favorable conditions central European lizards are known to shed more or less regularly every month. Yet "under adverse conditions the intervals become longer and in sickly animals the exuviation is omitted altogether. A corresponding variation also occurs in regard to the length of time required to complete the moulting process, which may be accomplished in two days by a healthy Lacerta, while unfavorable conditions may lengthen the period to more than a week" (Bruner, *lit. cit.,* p. 86).

The form which the moult (the shed epidermis) may take depends upon the species. Soft-skinned or granular-skinned species such as geckos tend to shed the "skin" in very large pieces, while some of the larger and rougher-scaled species, as for instance certain rough-scaled lizards, shed each scale separately. Moreover geckos shed over the entire body each time, whereas most other lizards, curiously enough, shed the epidermis separately on the body, head, and tail, each portion having its own distinct cycle. In general lizards shed the epidermis in more irregular pieces than snakes, which characteristically shed in one piece. When shedding, the lizard may rub itself about on objects to help loosen the old coat, and it frequently pulls off and swallows pieces. After the shedding the new epidermis that has formed underneath the old, shines brightly with vivid markings and colors; these gradually fade as the epidermis wears until finally another new layer forms just underneath the outer layer. The new develops minute rugosities that facilitate the loosening of the concealing coat, becomes corneous, and isolates the old layer from its communication with blood vessels, nerves, etc. Lymph may diffuse between the two layers. Eventually the superficial coat cracks in weak spots and is easily removed. The peculiar milky appearance characteristic of the eyes of many snakes shortly before shedding does not accompany ecdysis in lizards.

The shedding of the epidermis from the head is rendered difficult by the immobility of parts of that portion of the body, and by the close attachment to the several openings (lips, eyes, nares, ears). Offsetting these difficulties, a compensating "swell mechanism" occurs (in all groups of reptiles, including lizards), by means of which the animals can abruptly increase the blood pressure in the veins of the head over a 5- or 10-second interval, increasing very notably the size of the entire head. This swelling obviously aids in loosening the epidermis sufficiently that rubbing or scratching with the foot or hand will remove it. While the swelling generally involves the entire head, it may be restricted to the nasal region, or to the portion of the head at the rear of the nasal area. Unless restricted to the nasal region, the swelling is by far the most obvious about the orbits, which are usually protruded unbelievably far. This phenomenon can occur at any time; but since its main purpose

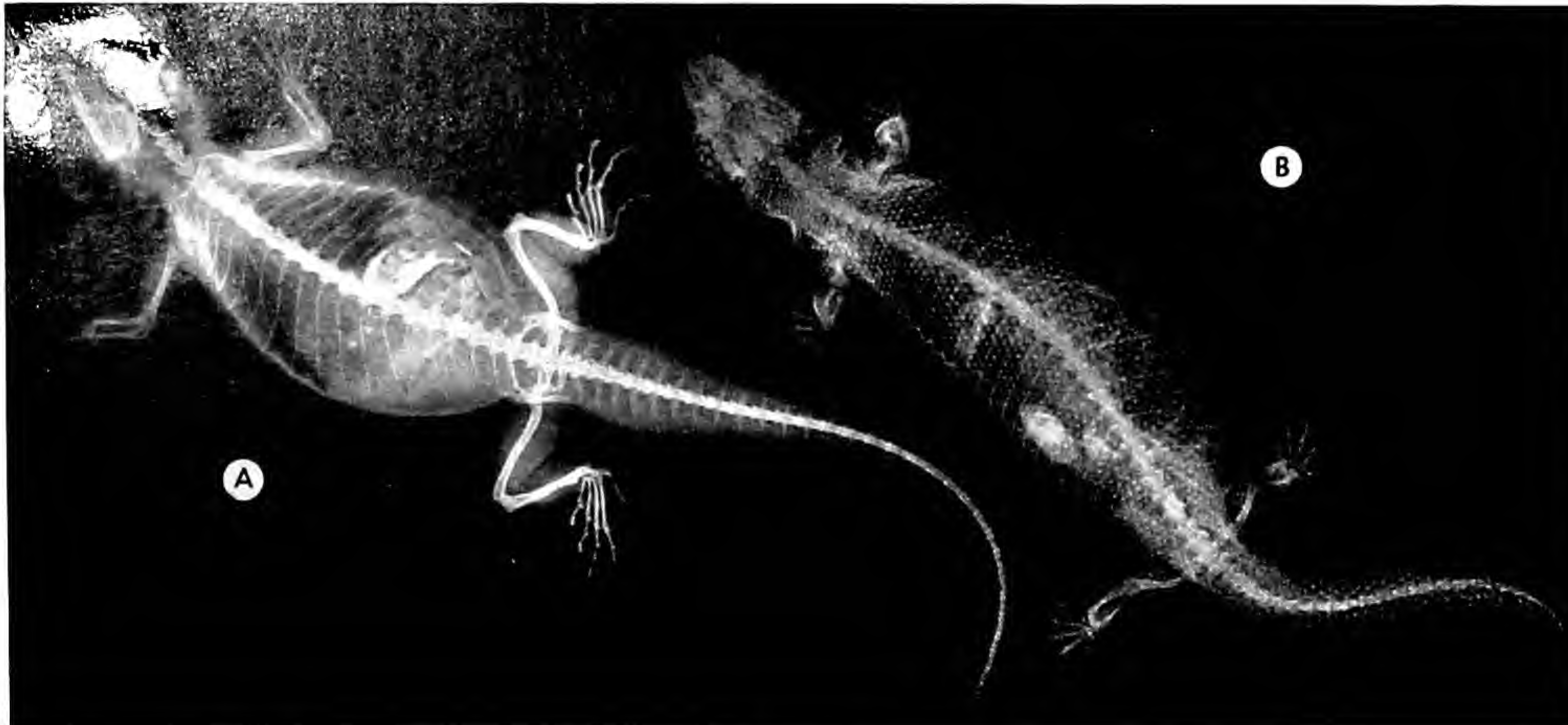
is to aid in ecdysis, it normally occurs only when that process is under way. The swelling can be produced experimentally, however, by placing a small section of gummed paper on the orbit of, for example, a horned lizard. Another function of the mechanism is well known in *Phrynosoma,* in which the thin walls of the nictitating membrane rupture upon exertion of the unusual pressure by the various muscles involved in the process, thus throwing a stream of blood sometimes a considerable distance (as far as 7 feet). The mechanical basis for producing the swelling is well known but rather complicated; it involves chiefly a constrictor muscle which closes the internal jugular vein, thus damming the blood in the head, and a hammock-shaped muscle under the orbit, which when it contracts increases the pressure upon a large sinus about the eyeball. A thorough account of this subject is given by Bruner (*lit. cit.*); a recent comment has come from Burleson (*lit. cit.*).

The scales of most lizards are rather soft structures, or at least they are after the epidermis, which is sometimes horny, is removed. But in certain families of lizards (Anguidae, Scincidae, Anniellidae, and Helodermidae in the United States) a plate of bone forms in the dermal layer of each scale in at least certain parts of the body. These bony plates are called osteoderms. They undoubtedly serve as added protection for their bearers. Their shape and other general features are, in general, characteristic for each family, but so far no success has attended efforts to use osteoderms as specific characters. The presence or absence of osteoderms can be simply determined by dissection, but they can also be demonstrated by means of X rays. The radiographs on page 8 (Pl. 1) compare a species with osteoderms with another that lacks them.

TEETH

In most lizards the teeth are numerous and arranged in a single row about the edges of the jaws. In the upper mandible the premaxilla and maxillae are involved, in the lower jaw only the dentary. In some families (Iguanidae, Anguidae, Scincidae, Lacertidae, and Teiidae) a few teeth may be present on the palatine bones. The form of the teeth varies somewhat between groups; it is not, however, generally used in defining genera or species. The teeth are commonly conical, but in the Iguanidae the posterior teeth are broadened and flattened lateromedially toward the tip and have 3 to 5 cones on the cutting surface. In the Agamidae the tooth modification is carried still further, to such a point that molars, incisors, and canines may be distinguished; the parallelism with the mammalian condition is emphasized by the fact that the molars are not replaceable whereas the other teeth are. In the Varanidae the teeth may take quite a different form, assuming in some species a broad, flat crown adapted to the crushing of crabs. Other varanids may have rather widely separated, simple, curved teeth.

Lateral compression of the teeth, particularly those of the rear part of the



Pl. 1. Radiographs of *Sauromalus obesus* (A) and *Heloderma suspectum* (B). Courtesy of Charles C. Leake.

jaw, is very common and can be seen in any iguanid. Compression in the other direction—i.e., anteroposteriorly—producing transverse instead of longitudinal crowns, is scarcely indicated in modern species, but is very evident in a recently discovered fossil family (see p. 5).

In all lizards the teeth are either pleurodont or acrodont. The former term applies to teeth placed against the inner surface of the jaws; practically all lizards have this type of tooth attachment. Only the Agamidae and Chamaeleonidae have teeth originating on the crest of the jaw bones; these are acrodont.

In snakes a marked specialization of the teeth has accompanied the evolution of a powerfully poisonous secretion of certain glands of the head. A similar modification has not occurred in lizards, perhaps because venomousness has never been highly developed either as a means of protection or of food capture. Only one small group of lizards, the two species of *Heloderma*, is known to be venomous, and only one other group is suspected of having venomous properties. Furthermore, the venom of these lizards appears to be rather variable in its effect, and thus perhaps weak in potency. In other words, it is not very well developed as a poison. In like manner the teeth can be said to be poorly adapted as an adjunct of the venom apparatus. In *Heloderma* practically all the teeth of the lower jaw are fairly large and widely spaced, and some three or four of the anterior ones on either side of the lower jaw are provided with feeble grooves, one on the inner surface of each. The venom, secreted into the mouth through ducts opening opposite these teeth, seeps along the grooves into wounds made by the teeth; there is no means for direct injection of venom as there is in many snakes.

One of the most extraordinary dental adaptations seen in lizards is the egg tooth. This is a transitory, dentine-covered, median tooth projecting forward under the upper lip from the anterior edge of the premaxilla. It appears in the embryo, reaches its greatest development at the time of the hatching of the egg, and disappears within a very few days after the emergence of the young from the egg, presumably at the time of the first ecdysis. Whether the structure occurs in live-bearing species is not known to me. Although it is said to be of universal occurrence in lizards and snakes, some geckos lack it; other geckos, curiously enough, are said to have a double egg tooth. An analogous structure, but epidermal in origin, appears on the snouts of turtle, crocodile, tuatara, and bird embryos. Only in mammals is there a possibly homologous structure; it is so reduced in size, however, that it is functionless in at least the shell-cracking respect. The only mammals with the presumed vestige are, of course, the egg-laying monotremes. The egg tooth of lizards is very sharp-edged, and like a razor slits the end of the eggshell from side to side when the lizard shakes its head laterally in the seemingly somewhat convulsive manner so characteristic of embryos. Only when the embryo has reached a size large enough to press the snout against the end of the shell can the tooth

pierce the latter. Thus three important factors enter into the emergence of the young from the egg: (1) attainment of a size sufficient to bring the head more or less forcibly against the shell; (2) proper development of the egg tooth; (3) the reflexive, side-to-side shaking of the head. Undoubtedly the failure of proper development of the egg tooth—in the proper place, to the proper direction, and to the proper size—accounts for a large proportion of the deaths of full-term embryos.

TONGUE

The tongues of lizards vary greatly in shape and general character. In some they are very elongate and bifid, similar to snake tongues; in others they may be short and thick, with no or little evidence of bifurcation. Most United States species have the latter type. The form of the tongue has not been used extensively as an identification character in connection with American lizards, although useful potentialities are suggested by Malcolm Smith's discussion of tongue form in Indian lizards (1935, *lit. cit.*).

The tongue functions as an olfactory organ. It may be applied directly to the object which is subject to the lizard's scrutiny, and in such cases the action is somewhat like "tasting" as known by human beings. In other cases the tongue detects air-borne odors, and thus serves the function familiar as "smelling." Both functions are closely co-ordinated; one does not exist as a strong sense without the other. Both functions are grouped under the olfactory sense. Most lizards are more sparing in the use of the tongue than snakes. They sometimes flick it out of the mouth, rather slowly, to determine the characteristics of food or eggs, but when being handled, or when alarmed, or in fact when doing anything except hunting for food or indulging in various "social" activities, the tongue remains in the mouth. This is quite contrary to the habit of snakes, which use the tongue a great deal under almost all conditions. Air-borne olfactory stimuli are received by the tongue to a greater degree in snakes than in lizards.

JACOBSON'S ORGAN

Intimately associated with the tongue as a detector of olfactory stimuli is Jacobson's organ, a structure derived at least embryonically from the nasal sacs and present in most terrestrial vertebrates but especially well developed in lizards and snakes. In the latter two groups the organ opens directly into the mouth instead of into the nasal passages and is of considerable importance in food detection. See Noble and Kumpf, and Wilde (both *lit. cit.*).

EYES

The eyes are absent or scarcely evident in several groups of burrowing lizards. In the United States this is true only of the amphisbaenids (two species). Others of this country have functional eyes, but they may vary in

size from the very small structures of *Anniella* to the relatively very large eyes of the nocturnal geckos. As a general rule burrowing habits are accompanied by a reduction in eye size, nocturnal nonburrowing habits by an increase.

The shape of the pupil varies from a circle to a vertical slit, the latter type associated with animals of nocturnal or crepuscular habits. Geckos, for instance, which as a rule wander only at night or evening, have vertical pupils. That is to say, the pupils are vertical when subjected to bright light; in darkness or dusk they are round. Because of this variability of pupil shape, it is frequently impossible to determine from preserved specimens whether the *contracted* form of the pupil is a slit or a round aperture. In preserved specimens the shape depends upon the time of capture and the effect of the preserving solution. At least it may be stated that presence of a vertical pupil is positive evidence of its contracted shape; the same cannot be said of the existence of a round pupil in any single specimen. For a discussion of many aspects of the reptilian eye, see Walls (*lit. cit.*)

Eyed lizards usually have eyelids. Exceptions among American lizards are most geckos and members of the Xantusiidae. The absence of movable lids in these two groups has a different explanation in each case. In the true geckos (subfamily Gekkoninae) there is a transparent disk over the eye, bordered by a rim of immovable, opaque tissue that represents the eyelids. In some species the rim widely overlaps the transparent disk. In the ground geckos (subfamily Eublepharinae) the rim of tissue appears as true eyelids. The transparent disk disappears as a separate structure. Therefore in geckos we can say the eyelids are absent because they have not yet developed.

In the case of the xantusiids the eyelids are present, but the lower has become enlarged and fused with the short upper lid, and in the middle of the lower lid a transparent disk has developed and so enlarged that the entire external surface of the eyeball is revealed. Thus in the Xantusiidae we can say that movable eyelids are absent because they have fused together, incidentally developing a transparent disk and thus avoiding blindness for these lizards. This, it is of interest to note, is presumably much the same sort of arrangement as in snakes, which like the xantusiids lack movable lids.

Conditions intermediate between the eublepharid condition (movable, opaque lids) and the xantusiid condition (fused lids, lower covering practically all of eye and becoming transparent) are shown by the skinks. Some species (e.g., *Eumeces*) have opaque lids, but, as in other lizards, it is the lower lid that closes the eye opening while the upper lid remains stationary. A number of darkly translucent, vertical plates may be present in the middle of the lid. In other species (e.g., *Leiolopisma*) a moderately large transparent "window" occupies the center of the lower lid, so that objects can be discerned to some extent even though the eyelids are closed. A final step is shown by a foreign genus (*Ophiseps*), in which the lower lid is fused to the upper, but

the transparent disk is not enlarged to cover more than perhaps half the external surface of the eyeball.

EARS

External ear openings are generally considered characteristic of lizards as opposed to snakes. While as a rule this is so, some lizards do not have external evidences of ears. Amphisbaenids and anniellids lack them, as do most other burrowing lizards over the entire world. One burrowing lizard, *Ophisaurus*, which like others of its habit group is without legs, has so recently adopted subterranean ways that its eyes and ears remain functional. One could hazard the guess that, with the passage of hundreds of thousands of years, these lizards too will become blind and deaf like so many other burrowers.

Two genera of iguanids show interesting states of degeneration of the ear. In one (*Holbrookia*) the tympanum is completely covered with granular scales, whereas in certain species of the other (*Phrynosoma*) the tympanum is scaly but with some care can be distinguished, at least in many specimens. In a single species the tympanum varies from complete indistinguishability to the normal condition.

A few groups of lizards show a beginning of an external auditory tube leading to a tympanum placed below the level of the skin (as in *Anolis* and many anguids and scincids), but in most groups the tympanum is nearly or quite on a level with the skin.

LIMBS

Almost everyone is aware that legs are the expected accouterments of lizards, and is consequently somewhat perplexed by the statement that lizards can lack legs. The question then arises of what makes a legless lizard a lizard instead of a snake, for one usually identifies legless reptiles as snakes. Anatomical evidence conclusively shows, however, that not all reptiles without legs are snakes, but that some are lizards. Some of the anatomical distinctions between these two groups are cited in the section entitled "Characteristics."

External limbs are absent in *Ophisaurus*, *Rhineura*, and *Anniella*, among the United States lizards. Many other genera elsewhere in the world lack them. All lizards, however, that lack external limbs still retain internal evidences of them or of one or both of the bony girdles that support them. A very few species lack the pectoral girdle and limbs, but at least the pelvic girdle is present.

In almost all limbed lizards the hind legs are better developed than the forelegs, and this may have some connection with the fact that in limbless lizards the pelvic girdle is generally retained longer than the pectoral girdle. A notable exception is *Bipes*, in which the front limbs, although rather small, are better developed than the rear limbs, which are absent externally.

Invariably in lizards the fourth digit of the foot is longest, and generally

this is true of the hand as well. The fingers and toes are variously adapted for the substratum on which the lizards live. Iguanids as a general rule have curious longitudinal keels (about 3 to 7) on the undersurface of the toes, presumably to act as friction ridges. Most geckos and all of the anoles have developed adhesive pads at or near the tips of the digits. *Uma* has developed fringes along the toes to serve as an aid in locomotion on and under sand; *Gambelia* has somewhat similar but much less well developed fringes. In most other lizards the digits are more or less cylindrical.

The claws in some foreign geckos are retractile into a terminal sheath of scales. They are fixed in all American species. They are usually elongate in terrestrial species and tend to be short and heavy in arboreal forms.

GLANDS

Reptiles in general are very meagerly supplied with integumentary glands. Many groups of lizards are provided with preanal or femoral pores, but other noteworthy integumentary glands are lacking. In North America these pores are found in some geckonids, most iguanids, all xantusiids, lacertids, and teiids, and in some amphisbaenids. In but few species do preanal pores occur (geckonids and amphisbaenids). In no species do both preanal and femoral pores occur as separate series, although in some the femoral pores may form a continuous series from side to side across the median ventral line. The preanal pores are located in the rather clearly circumscribed preanal area, in a more or less v-shaped series with the apex directed forward. Foreign species may have them arranged in clusters. The femoral pores are usually in a single series on each leg, but they may tend to double up in certain species with very numerous pores. The number of pores is a character useful in determining differences between some species and subspecies. The variation in number seems generally to occur on the distal ends of the series, the medial ends being more or less constant. Sometimes it is difficult to determine just where the series terminates distally, but medially the pores are well defined.

As a general rule the pores are better developed in males than in females. I know of no exception among United States species. The pores are frequently difficult to distinguish in females, and may actually be absent in females of a very few species.

The pores are really integumental glands formed of the epidermis infolded near the middle of a scale. The glands are particularly active during the mating season, secreting a corneous substance that may project fingerlike a considerable distance from the glands. At certain seasons the secretions collectively may form a comblike structure on the undersurface of the hind legs. The individual "tines" have little resilience and break off after a short time. Apparently the organs have the sole function of stimulation of the female in courtship and mating activities. Therefore in females they are vestigial.

The mouths of lizards are provided with various glands that secrete mucus

and thus aid somewhat in the swallowing of food. In *Heloderma,* the only genus of venomous lizards, the secretions of certain of these glands in the lower jaw are so modified that they can cause serious illness and perhaps death to an animal that is bitten (see discussion pp. 9, 474). The glands open by slender ducts into the floor of the mouth near the teeth, but have no connection with the teeth, even though some of the latter are grooved.

CLOACA

The ducts of the digestive, reproductive, and urinary systems enter a common vestibule before reaching the exterior. This chamber is the cloaca. Just behind the cloacal opening (anus) in certain geckos a pair of narrow, transverse, slitlike openings occur, leading into shallow pockets under the skin (see further discussion under the family Gekkonidae).

The copulatory organs are situated in the base of the tail in males. They are of much the same character as those of snakes. The organs are a pair of rather thick-walled sacs which normally lie inverted in spaces between the basal tail muscles, one on either side of the median line, and opening into the posterior dorsal wall of the cloacal chamber near its opening to the exterior. A retractor tendon is attached to the tip of the sac. In copulation only one organ is used at a time, although either can serve. The hemipenis (as each copulatory organ is called) is everted upon contact of the cloacal walls of the male and female and is retained in the female cloaca until copulation ceases. Upon withdrawal the hemipenis inverts into its sheath. In snakes the inversion usually takes place while the animals are still attached, since their hemipenes are provided with spines. In lizards the everted hemipenis displays various flounces and irregularities of contour, but spines are absent. These structures are of great taxonomic significance in snakes, but they have not been so utilized with much success in lizards.

TAIL

The form of the tail varies greatly in lizards. It may be extremely short or three times as long as the head and body. It may be of the same diameter as the body or of widely different dimensions. Some species have laterally compressed, others dorsoventrally compressed, tails. With but very few exceptions the tail tapers distally. It may be provided with the same sort of scales as the body or with very different ones. Generally a regenerated tail has a different type of scalation than the original, and Boulenger (*lit. cit.*), as well as others, has theorized that the regenerated form is a more primitive type than the original. The theory is debatable. Noble and Bradley (*lit. cit.*) have shown that the form of the scales on the regenerated portion is strongly influenced by temperature.

Regeneration is a well-known faculty of lizard tails. Some species part with their tails upon the slightest provocation, either of their own will or in re-

sponse to a slight blow (i.e., by autotomy), so that very few ever reach a museum with a complete, original tail. Other species shed them only under great stress. It is probable that readiness to break the tail is directly correlated with ease of regeneration. Certainly it is clear that species like geckos and "glass-snake" lizards, which break the tail very readily, quickly regenerate fair facsimiles of the original. On the contrary other species, like the collared lizards, part with the tail only with the greatest reluctance and may never grow a new tail.

The fracture of a lizard's tail always, so far as has been observed, occurs near the middle of some tail vertebra just posterior to the transverse process in a plane of unossified tissue rather than between vertebrae. The position of the fracture corresponds with that of the myosepta and associated segmentally arranged structures, thus facilitating an easy separation. An interesting adaptation to autotomy of the tail is the presence of a sphincter muscle about the caudal artery in front of each autotomic plane; this sphincter closes when the fracture occurs and prevents undue loss of blood. This is, apparently, the key to regeneration, for tails experimentally broken between vertebrae are not replaced. It would be of interest to test tail fracture in species that do not regenerate; it is suggested that the rule of fracture in the middle of a vertebra finds an exception in such lizards, and thus the failure of regeneration may be explained.

An incomplete fracture of a tail causes the growth of a new tail almost as though the fracture were complete. In such manner arise forked tails or growths from otherwise normal tails. Under properly controlled conditions it should be possible to produce experimentally branched and rebranched tails far different from the normal. No lizard normally has a branched tail, but any lizard capable of regeneration can and probably does produce such variants on rare occasion.

Regeneration never involves restoration of vertebrae; instead a cartilaginous rod grows posteriorly. Muscles are provided in the new tail, but neither they nor any other structures on the regenerated portion show evidence of segmentation.

The primary uses of the tail are three: grasping, balancing, and storage. In all lizards, apparently, the tail is important as a storage organ for fat. Lizards of northern climes, which must hibernate or remain inactive over relatively long periods, are of course more dependent upon the tail for the performance of this function than are many tropical species. It is of interest to observe that northern or high-elevation species likewise show considerably greater reluctance to part with the tail, filled with their hard-earned and much-needed fat stores, than tropical species in general. In *Heloderma* the tail is extraordinarily large and fat, and is apparently modified in such a manner largely for the better performance of this function of storage. In most lizards no special change in shape adapts the tail for this function; presumably agility of the

tail, which aids balancing and grasping, is of greater selective value in most lizards than ample storage space.

No American lizards have markedly prehensile tails, although in some groups (*Gerrhonotus*) they occasionally may be used crudely to hook over limbs and twigs and thus prevent falling. The lizards with the most prehensile tails are the true chameleons of Africa and adjacent lands.

In practically all United States lizards the balancing function of the tail is the most important. Those which have lost their tails frequently run or climb clumsily. Lizards that run on their hind legs, such as collared lizards, for greater speed rely upon the tail to balance the uplifted fore part of the body; they are therefore incapable of such antics when deprived of their tails.

SEXUAL DIMORPHISM

In one family of lizards, the Iguanidae, there are marked differences between the two sexes. In this family the males are usually smaller than the females, are more brilliantly colored, sometimes even have a different pattern, and generally are provided with a pair of enlarged scales just posterior to the anus. The latter feature, of very practical use to the herpetologist in distinguishing sexes, is not evident in all genera of the family, and even in those genera where it occurs some species may regularly lack it. In a few species the character is variable from one individual to the other. In spite of these exceptions the presence or absence of these enlarged scales is the first thing to look for in determining the sex of a lizard; if the enlarged scales are there, the animal is without doubt a male; if all the scales are small, other means must be resorted to unless it is known that for the particular species in hand small scales determine females.

One genus of iguanids, *Anolis,* shows still another sexual dimorphism: the presence or absence of a well-developed gular fold mechanism. This is a remarkable morphological divergence between the sexes probably paralleled in importance by no other in lizards.

In other families of American lizards there may or may not be a difference in color, pattern, or size between males and females; differences are less evident in the less primitive families. Size cannot be used as a criterion of sex unless the total size range for both sexes is known; it is of use in such determinations only for large specimens. However, it is not known whether or not there are maximum size differences between the sexes of all species.

Adult males of many species have notably broadened heads, mainly owing to enlarged jaw muscles. These muscular areas of the head, in the temporal region, may become pinkish in the mating season only or may remain of that color at all times. The muscular enlargement in males finds a possible correlation in the fact that the females are usually gripped in the jaws of the males, generally in the neck region, during copulation.

There are numerous species of lizards, for example many skinks, geckos,

etc., that show no noteworthy sexual differences externally at any time in their lives. For purposes of the student, the sexes of such species must be distinguished by dissections to reveal the internal reproductive organs of the abdomen or the hemipenes.

DESCRIPTIVE TERMINOLOGY

With very few exceptions[3] the entire body of all lizards is normally covered with scales the forms of which vary greatly. The extent of variety increases in direct proportion with the magnitude of the taxonomic category; i.e., in the least category, of species or subspecies, the variation is relatively small, while within a genus the variation exhibited among several species may be considerable; families exhibit a still greater variety, etc. The fact that there is a strong degree of constancy within groups has led to the adoption of a special terminology for scale types and even for individual scales. The head scales are, almost exclusively, the only ones given individual names; the scales on the body and tail are known only by regional and type names. To some extent it is advisable and even necessary for anyone who wants to study lizards to know some of these terms. Many of them can be learned from the figures illustrating the generic types; but even by this means the general use of the terms is not always clearly evident. For that reason a nearly complete list of the less immediately understandable descriptive terms usually encountered in studies of the external features of lizards is included in the following pages.

The head scales are of great importance taxonomically. Although subject to variation, the amount of variability is sufficiently limited to permit use of many of their characters to define species. A scale or group of scales constant within certain prescribed limits in one group may, however, be so variable in other groups that they are useless taxonomically. In some groups with large scales every head scale is of more or less constant form, while in others with smaller scales individual plates may show little constancy. It is important, however, that the variability of head scales within species not be overestimated; only recently, for instance, has it become apparent that many more reliable characters exist in the scalation of the head in the notoriously variable genus *Sceloporus* than was ever before suspected. Close study of genera in which the scalation has previously been considered hopelessly variable can be expected to yield useful information in many cases.

Although for the most part one set of names and descriptive terms for scales are in general use for all lizards, in some few cases the names have been applied to widely different scales in different genera, even though the homologies may very readily be apparent. Clearly the nomenclature should be uniform for all lizards, insofar as this is possible. The system of nomenclature

[3] The skin lining certain pockets, as for instance on the side of the neck, in the axilla, or in the groin, is scaleless.

used in this book was adopted with the end in view of applying the terms most appropriate, by general use or by meaning, for the greatest number of genera occurring in the area considered. The following definitions and discussions are restricted entirely to United States species. Yet very possibly the definitions determined by the scale patterns of these forms will find ready application to those of other regions. The list of terms includes some not in general use in response to the general and urgent need for a means of concise description of the limbs. In order to reach a uniform definition for all terms some changes from current procedure in a few limited groups (genera) have been required. The changes are indicated in the following definitions.

Obviously it has been impossible to arrive at complete uniformity for all scales in all species, since homologies are not clear in many cases. In other cases only small scales occur in certain areas which in other lizards are occupied by one or a few large, named scales; it is generally admissible to use those names for the corresponding *regions,* but clearly the several regions usually cannot be sharply delimited one from another. Many of the terms used in a regional sense are shown in Fig. 60 (p. 102). The variability of scales of moderate size is also a hindrance to uniform nomenclature. There is nothing gained by an attempt to name and account for each scale in lizards except perhaps in very detailed studies of all known species. Finally, in some species the plates or scales that are well differentiated in related species are in these indistinguishably fused together, so that several names could be applied correctly to a single scale. In such event the use of combined terms is optional; generally the name of the most prominent contributing scale is retained.

Dorsal Head and Neck Definitions

rostral—the scale at the tip of the snout, bordering the lip. It may be concealed from dorsal view by an overhanging shelf, as in *Rhineura,* but it is generally visible. In only one genus, *Sauromalus,* is it subdivided, although in many geckonids it is split posteriorly. It is universally present.

postrostrals—a small scale or a series of small scales bordering the rostral posteriorly. The scales occur in all iguanids, in both anguid genera, but only in certain species of *Gerrhonotus,* and in the Helodermidae; they are unknown in other families.

internasals—a single or double pair of scales, or an irregular group, between the nasal scales. All scales in the area between the nasals may be considered internasals, except supranasals and certain other scales which in some genera may enter the area secondarily. Internasals occur sporadically in the Geckonidae, but are usually absent; they are regularly present in the iguanids, xantusiids, anguids, and helodermatids; they are absent in other families. In most anguids anterior and posterior pairs may be distinguished;

these are conveniently termed *preinternasals* and *postinternasals* respectively. There is evidence, however, that the preinternasals are actually modified postrostrals; if this evidence is borne out a different terminology may be advisable.

supranasals—a scale bordering the nasal scale above, sufficiently well distinguished from other scales above and between the nasals to deserve a different name. Clearly the scales bordering the nasals medially (above) are not always to be distinguished as supranasals, but rather as internasals. Choice of the proper term when neither *supranasal* nor *internasal* is clearly indicated should rest upon the nature of the scales in related species and genera. For instance, the term *supranasal* is used in *Phyllodactylus* and certain other geckonids for the single pair of scales between the nasals because of the occurrence of other scales on the median line, dividing the supranasal pair, in *Sphaerodactylus* and other genera (extralimital). The scales are distinguished in all geckonids, some iguanids (the term could be used in many other iguanids if desired), skinks, anguids, and helodermatids.

canthals—the scale or scales that form the apex of a ridge extending from the anterior medial border of the eye to or nearly to the naris. This ridge is the *canthal ridge* and separates the sides of the snout between eye and naris (*lores*) from the dorsal surface. In number the scales may vary from 1 to about 6, the maximum occurring in *Anolis*. Although a canthal ridge is almost universally present, at least feebly indicated, canthal scales are distinguished in but few families. They occur in all iguanids and anguids (fused with loreal in some *Gerrhonotus* species) and could be distinguished in helodermatids, but they are elsewhere unknown.

supercanthals—in *Ophisaurus* a paired, longitudinal series of scales varying in number from 1 to 3, usually continuous anteriorly with the superciliary series, which is inserted between the canthals on the sides and the frontonasals and prefrontals medially. Were only one scale present on either side they could be interpreted, possibly, as lateral frontonasals. Since a series of three is usual, a special term for them seems necessary. The lateral frontonasals are regarded as absent.

frontonasals—the scales bounded by the internasals in front, the prefrontals posteriorly, and the loreals laterally. In the absence of some of the bordering scales the frontonasals may be identified by the position indicated in the preceding definition. The scales may be very irregular, as in many iguanids; a transverse row of three scales may occur, as in *Sceloporus* and related genera; or a single median scale may be present. Where three are present, the lateral scales are called *lateral frontonasals*, the median one the *median frontonasal*. In some older works the median scale was called an *interfrontonasal*, but the term is somewhat confusing if an attempt is made to apply it widely. Species with a single frontonasal are regarded as having

been derived from forms with three frontonasals; thus in some species the single scale is known in older works as the interfrontonasal. In the absence of fairly clear evidence of such an evolution, however, it is preferable to call the single scale simply a frontonasal. In *Gerrhonotus* the term *azygous prefrontal* is in popular use for a scale which very clearly is homologous with the frontonasal of other lizards; it is to be recommended that the special term be dropped.

The scales can be distinguished in all genera except *Anniella* and *Bipes*, and in the latter genus the frontonasal is probably present although fused with other scales. All species of other genera have one or more frontonasals except for a few in *Gerrhonotus* and *Eumeces*.

prefrontals—a scale or scales immediately preceding the frontal, between the anterior margins of the orbits. Usually a pair, sometimes split, occurs, but in many iguanids the scales are small and irregular, and in *Rhineura* it is single. The scales occur in some form in all genera except *Neoseps* and *Bipes*, and in both of these exceptions it appears very probable that the scales actually are present but merely fused with adjacent scales.

frontal—a scale or scales between the middle of the orbits. It is universally present, but it may be irregular as in geckonids, helodermatids, and many iguanids, divided transversely in many other iguanids, or single as in a few iguanids and all other families and their genera.

frontoparietals—scales between the parietals and the frontal. They may be irregular as in primitive families and genera, paired as in most lizards, or single (*Anniella* only). They are absent only in *Neoseps* (apparently fused with the frontal) and the two amphisbaenid genera.

interorbitals—in genera in which the dorsal head scales are small and irregular the scales between the orbits are frequently termed *interorbitals*. The name should be used only as a collective term for scales among which frontals, prefrontals, and frontoparietals cannot be distinguished, or for these three sets of scales together. The term finds its most useful application in the geckonids, iguanids, and helodermatids.

supraorbital semicircles—in some iguanid genera (*Anolis, Holbrookia, Uma, Callisaurus*, and *Crotaphytus*) the prefrontals, frontals, interparietals, and parietals form a paired, semicircular series of scales which are conveniently termed *supraorbital semicircles*. This term, like the preceding, should be used only in a collective sense, although in a considerably more restricted way. In *Anolis* an elevated ridge follows the anterior portion of the supraorbital semicircles and anteriorly curves medially across the lateral frontonasal region, thus enclosing a depression in the prefrontal and median frontonasal regions. These ridges are known as *frontal ridges*.

interparietal—a median scale posterior to the frontal, sometimes separated from the latter by the frontoparietals, in which or below which the parietal

"eye" occurs. The scale is not distinguishable in the geckonids and helodermatids but is present in all other families and their genera with the exception of the amphisbaenids. In some primitive iguanids with small head scales the scale is not readily distinguishable, but in all others it is clearly differentiated. In most iguanids the parietal "eye" is easily visible in the scale, but this is not so in other families.

Unfortunately in *Anolis* the term *occipital* has gained popular use for this scale. The application is inappropriate.

parietals—scales posterior to the frontoparietals, bordering the interparietal, if present, on either side. In many lizards the scale is paired, in a few two parietals on each side are distinguished, and in others the scales of that area are small and irregular; but never is there a single, median parietal. In the absence of an interparietal the scales may be in contact on the median line, but otherwise those of the two sides are separated, usually widely, middorsally. The scales are universally present.

interoccipital—in some lizards a median scale occurs posterior to the interparietal; this is known as the *interoccipital*. It is single except in some species of *Gerrhonotus*, in which it may be subdivided into several small scales. Because of the inconstancy of the scales of the head posterior to the interparietal the term is not of wide usage; it finds useful application in some iguanids and in xantusiids, teiids, anguids, and *Anniella*.

occipital—head scales (exclusive of the unpaired median interoccipital, if present) posterior to the parietals and interparietal. This term can be of wide application; only in the Scincidae is the term to be avoided.

supraoculars—the scales above the orbits. Many small scales may be involved, or only one on each side, or in rare cases (*Rhineura* and some species of *Xantusia*) none.

superciliaries—the series of scales at the edge of the orbit dorsally. They may be very small, enlarged, or absent; only in the Amphisbaenidae and *Neoseps*, however, are they missing, although in one species of *Gerrhonotus* the series is reduced to one scale. In most iguanids they are very elongate and lie one over the other; such a condition is described as imbricate. Spines are developed within the series in geckonids (in the middle of the series) and in *Phrynosoma* (at the posterior end of the series); they are called *superciliary spines*. That of *Phrynosoma* is generally known as the *postocular spine* or *horn*, but the term is inappropriate.

The series may comprise well-differentiated and imbricate scales anteriorly or very poorly differentiated scales posteriorly, as in *Anolis*. All are superciliaries.

circumorbitals—in most iguanids and in some teiids a series of small scales which partially or completely separates the enlarged supraoculars from the

prefrontals, frontals, frontoparietals, and parietals. These scales may be known as *circumorbitals*.

nuchals—the dorsal and lateral neck scales. *Lateral nuchals* are those on the side of the neck, whereas the *dorsal nuchals* are usually referred to simply as *nuchals*. In some genera the term has been given a more restricted meaning, being applied only to the enlarged scales on the dorsal surface posterior to the head, as in *Eumeces*. However, it would seem preferable to give such specialized nuchals a separate name; the term *jubals* is suggested.

Lateral Head and Neck Definitions

prenasal—a scale preceding the nasal. The scales surrounding the nasal scale may be described, by position alone, as prenasals, supranasals, postnasals, and subnasals. That the various lizard scales known by these names are homologous is highly improbable. Yet for the sake of convenience and in the absence of the means to trace homologies, use of the terms when conditions suggest them is to be encouraged. The prenasal may well be a postrostral. It may be distinguished in geckonids and iguanids.

nasal—the scale in which the nostril (naris) is pierced. It is always single in lizards and is at times reduced to little more than a narrow border about the nasal opening. Universal.

postnasals—one or two scales behind the nasal. These are the most constant and most widely occurring of the circumnasal series mentioned above. They are absent only in *Neoseps*, amphisbaenids, *Anniella*, and some species of *Eumeces*.

Fitch distinguishes four postnasals in *Gerrhonotus* on each side, but this is improper; the posterior pair consists of an anterior canthal above and an anterior loreal below.

subnasals—the scale generally distinguished as a subnasal is one in the canthal series which lies immediately below the nasal. The term is most frequently used in *Sceloporus*, although it could well be used in other iguanid genera. No other family possesses these scales.

loreals—scales on the side of the head between the preoculars and postnasals, and below the canthals. The number of scales may vary from 1 to perhaps 20. In *Anolis* they are arranged in longitudinal rows, and in this genus not the loreals themselves but the number of *loreal rows* is of taxonomic importance. The scales are absent only in *Bipes* and *Anniella*.

lorilabials—an irregular, longitudinal group of scales between the loreals and labials, or posteriorly between the subocular and labials. These scales are continuous anteriorly with the postrostrals, if the latter are present, and are to be considered as merely modified loreals at least anteriorly. They occur in most geckonids and iguanids, and in *Ophisaurus* and *Heloderma*

preocular—one or several scales bordering the orbit anteriorly on its upper margin, some generally in contact with the superciliaries. The scales are present in all lizards except *Neoseps,* but in geckonids they are not differentiated from other scales around the orbit.

subocular—a series of scales or, more typically, one elongate scale below the orbit, in contact with the preoculars anteriorly. Where several suboculars occur, in some cases as in *Eumeces* it is convenient to distinguish *presuboculars* and *postsuboculars.* In some genera, particularly of iguanids and teiids, two suboculars occur, the anterior one of which is small and much like a preocular; this anterior scale is called a *frenocular* in some works. Suboculars are present in all lizards except *Anniella,* although in geckonids they are not differentiated and in many iguanids are poorly differentiated.

postoculars—one or more scales bounding the orbit posteriorly between the superciliaries, and supraoculars, and the suboculars. In many iguanids the upper posterior border of the orbit is not bounded by enlarged scales but by very small scales and granules. These granular scales are also postoculars, although they may be very different in character from the larger, lower postoculars. The entire orbit may be bounded except above by small scales indistinguishable from one another except by position. In such cases the terms preoculars, suboculars, and postoculars are used arbitrarily with a regional meaning.

Postoculars are present in all lizards, although in geckonids they are not differentiated from other scales around the orbit, and in many iguanids are only incompletely differentiated.

supralabials—the scales bordering the upper edge of the mouth except at the tip of the snout where the rostral occurs. No other scales reach the lip.

postlabials—scales posterior to and in line with the supralabials. The term is used only when the scales in the position described are well enough differentiated to be of importance. In only four genera (*Eumeces, Leiolopisma, Gerrhonotus,* and *Ophisaurus*) do they seem of significance.

temporals—the scales above the supralabials, behind the postocular, and below the parietals and occipitals. These are small or irregular in many genera, but in others are of considerable size, regularity, and significance. When the scales are fairly well developed they appear to form irregular transverse rows. The scales of the anterior row are termed *primary temporals,* those of the next row posterior are termed *secondary temporals,* the following row the *tertiary temporals.* Further rows are scarcely distinguishable. Temporals are universally present.

supratemporals—in species which have small, irregular temporals, those in the upper portion of the temporal area (in a dorsolateral position in some as in *Ctenosaura,* or in a more dorsal position in others as in *Xantusia*) are

sometimes notably enlarged. It is convenient to term these enlarged temporals the *supratemporals.*

ciliaries—these are the small, rectangular scales bordering the edge of the eyelid. *Upper* and *lower ciliaries* are distinguished on the upper and lower eyelids, respectively. They are present in all species with eyelids and are therefore absent only in most geckonids and all xantusiids and amphisbaenids. In iguanids the rows are double, but in all other groups, when present, the ciliaries are in a single row on each lid.

palpebrals—the scales covering the eyelids. *Upper* and *lower palpebrals* are distinguished on the upper and lower eyelids. Upper palpebrals, however, are clearly in evidence only in *Coleonyx,* the Iguanidae and the Teiidae; they are poorly in evidence in the anguids and helodermatids, and absent in the scincids and anniellids. The last four families mentioned possess eyelids, but the upper one is very short; in the first two it is slightly movable, and in the last two immovable. Lower palpebrals are present in all the families named except the anniellids. In *Eumeces* a central row of palpebrals is considerably enlarged, and in *Leiolopisma* and *Neoseps* these are fused to form a single, large *palpebral disc.* Since eyelids are lacking in the geckonids (except *Coleonyx*), xantusiids, and amphisbaenids, no palpebrals occur in these families; and as mentioned before the anniellids lack them because of the very poor development of the eyelids.

ocular—a scale covering the eye. This occurs only in the degenerate, burrowing genera of the amphisbaenids, in which the scale is darkly translucent, and in the xantusiids, in which the scale is nearly transparent. In both cases the scale has been formed from an eyelid (see discussion p. 11). The geckos (except *Coleonyx*) appear to have eyes like *Xantusia,* but in reality they have no lids at all nor have they ever had them.

auricular lobules—modified scales bordering the ear opening anteriorly.

tympanum—the membrane stretched across the ear opening. It is near the surface in some genera; in others it is withdrawn into the body and is scarcely visible at the end of the *auditory canal* (e.g., *Anolis*). The tympanum, though at the surface of the body, may be concealed by camouflage, possessing scales exactly like those of immediately adjacent areas, as in some species of *Phrynosoma.* In others the ear opening has narrowed and closed completely, so that the tympanum if present is buried under a layer of skin and muscle of varying thickness, as in *Holbrookia, Neoseps,* amphisbaenids, and *Anniella.*

external auditory meatus—the ear opening in those cases in which the tympanum has receded into the body, and a canal, however large or small, leads from it to the surface.

lateral nuchal pocket—a pouchlike structure on the side of the neck. Ventrally it is connected or in line with the pregular fold. It occurs only in certain genera of iguanids, as in *Sceloporus*, etc.

Ventral Head and Neck Definitions

mental—a scale at the anterior median edge of the lower lip. It is single in all species except *Anolis*, in which it is split medially. It is of universal occurrence.

infralabials—the scales bordering the lower edge of the mouth, except at the anterior median tip, as far posteriorly as a point about even with the posterior edge of the orbit. This posterior limit is in reality more accurately fixed by the position of the vertical, or usually somewhat diagonal, wall of tissue, the masseter muscle and surrounding membranes, passing from the lower jaw to the upper. This wall marks the angle of the mouth. In geckonids, in primitive iguanids such as *Anolis, Ctenosaura, Dipsosaurus, Crotaphytus*, etc., and in fact in all other families the infralabials terminate at the true angle of the mouth (*rictus oris*). But in most iguanids the series of infralabials is extended back of the angle of the mouth for the length of about two to four scales. This posterior extension of postlabials occurs in *Sceloporus* and all its related genera, but is mostly clearly evident as something different from the infralabials in *Callisaurus* and its relatives, and in some species of *Phrynosoma*. In all genera in which postlabials occur, they can be distinguished from the infralabials by separating the "lips" carefully near the angle of the jaw; the wall of tissue marking the true *rictus oris* will be visible, and on the side of this wall numerous small scales are usually evident. These small scales can be seen in *Callisaurus* and related genera even without opening the mouth. In *Phrynosoma* the posterior scales are much enlarged, when present, and are usually known in that genus as *subrictals*. Since not all the postlabials are thus greatly enlarged, use of the name may be warranted.

postlabials—enlarged scales continuous with the infralabials posteriorly (see preceding paragraph). They are comparable to the postlabials of the upper jaw; to distinguish the postlabials of the two jaws those of the upper jaw are called *upper postlabials*, those of the lower jaw *lower postlabials*. The latter occur in many genera of iguanids but are unknown elsewhere.

subrictals—the posterior postlabials, if these are differentiated notably from the anterior postlabials. They are generally distinguished only in certain species of *Phrynosoma* (*coronatum* and *douglassii*).

postrictal—the most posterior postlabial, if this is distinguished from the subrictals as well as from the anterior postlabials. The term is used in two species of *Phrynosoma* (*coronatum* and *douglassii*) only.

sublabials—the scales bordering the infralabials medially, except as those scales can be distinguished as chinshields or postmentals. Typically several irregular series of sublabials are inserted between the infralabials and the enlarged chinshields. In the absence of chinshields the scales bordering the infralabials are sublabials. These have been termed by some authors the *labiomentals,* but that designation is inappropriate not only because *sublabial* has long been in use for the same scales but because the scales regarded as postmentals are actually better known as *chinshields.* Thus *labiomental* loses its meaning and preferability.

Sublabials are present in all lizards except some species of *Phrynosoma,* the scincids, xantusiids, and teiids. In these the chinshields are in contact with the infralabials.

chinshields—a paired series of enlarged scales extending posteriorly from the mental or postmental. The series may be in medial contact anteriorly but diverge laterally toward the posterior. These scales have been known in *Phrynosoma* as *sublabials* and in *Sceloporus* as *postmentals,* although in other genera they have generally been termed chinshields. It is of course preferable that the latter, the most widely used and probably most appropriate term, be universally adopted for homologous scales. The scales are absent only in the geckonids, some primitive iguanids, a few amphisbaenids (perhaps), and in *Heloderma.*

postgenial—in *Eumeces* and perhaps elsewhere the posterior scale of the chinshield series is so different from the rest that it is known as the *postgenial.* The term could be applied in any group to one or more of the posterior chinshields.

postmentals—unpaired or paired scales following the mental along the midventral line. When the scales are paired and in series with the chinshields, it is debatable whether to distinguish them from the latter; no general rule to determine this seems feasible. The condition in each genus should be considered separately, the decision depending upon the usefulness of the distinction, the differentiation from the chinshields, etc. Unpaired median scales following the mental are invariably termed *postmentals.* In no genus does more than 2 unpaired or 1 pair of postmentals occur, except in *Heloderma,* in which the chinshields are absent and about 5 pairs of postmentals form a median ventral series. In some geckonids and primitive iguanids the scales posterior to the mental are small or irregularly enlarged, but those adjacent to the mental, in the "postmental position," may be termed *postmentals.* With such an interpretation, postmentals may be recognized in all United States genera except perhaps *Rhineura.*

gulars—the scales enclosed in the area between the infralabials of either side, the position of the gular fold posteriorly, and the mental anteriorly are, except as sublabials, postmentals, and chinshields are differentiated, re-

garded as gulars. They may be variously modified as in some *Cnemidophorus* and *Phrynosoma* species.

gular fold—the granular fold crossing the ventral surface immediately in front of the forelegs. The fold is bordered anteriorly by larger gular scales and posteriorly by larger ventral scales. The structure occurs in many iguanids, and in all xantusiids, teiids, and helodermatids; it is less well developed in the geckonids and is feeble in *Bipes,* but is completely absent in the scincids, anguids, and anniellids.

pregular folds—in some species 1 or 2 granular folds, generally feeble but sometimes well developed, occur in front of the gular fold. These are the pregular folds, which are best developed in a few iguanid genera and in *Cnemidophorus.*

mesoptychials—the scales between the pregular and gular folds or, in the absence of a pregular fold, immediately preceding the gular fold.

Body and Tail Definitions

dorsals—the scales on the back or on the upper surface. The dorsals are counted from the posterior head scale (generally the interparietal), in a straight line at or near the middorsal line as far back as a line about even with the posterior margins of the thighs, when the hind legs are held at right angles to the body. In all species except those with very small or very irregular dorsals the dorsal count is of great importance, since it reflects especially the size of the scales.

ventrals—the scales on the underside of the body. They are usually counted from the posterior edge of the gular fold, or in its absence from a line even with the anterior margins of the forelegs, to the anterior edge of the anus.

laterals—the scales on the sides of the body. The only common scale count that takes these into consideration is the count of "scales around middle of body," which is taken about halfway between the forelegs and hind legs.

preanals—the scales immediately preceding the anus, if the scales are enlarged, or, if all are small, the scales in the preanal area. The preanal area is well outlined in most iguanids as a somewhat V-shaped area (apex forward and cut off) in front of the anus, bordered on either side by small postfemoral scales, and terminating anteriorly at the median ends of the femoral pore series.

axillary pocket—a pocket at the posterior margin of the insertion of the foreleg. Well developed in some skinks, feebly developed in most other lizards.

postfemoral pocket—a pocket at the posterior margin of the insertion of the hind leg (see Fig. 74, p. 181). Occurs in a few iguanid genera (some species of *Sceloporus* and related genera).

pectorals—the chest scales on the ventral surface of the body.

abdominals—the belly scales.

interfemorals—the ventral scales between the hind legs.

subcaudals—the scales on the underside of the tail.

caudals—tail scales.

enlarged postanals—enlarged scales posterior to the anus, surrounded by smaller scales. Characteristic of males of many iguanids.

caudal whorls—rings of scales about the tail. Regular whorls occur in many groups but are notably lacking in the scincids and anniellids.

lateral fold—a usually granular fold of skin along the sides of the body. Unless the body is distended the large ventral scales usually overlap the large dorsal scales so that the granular scales in the fold are concealed. In *Ophisaurus* the lateral fold is a thickening. In *Urosaurus* the "folds" are ridges.

Limb Definitions

suprabrachials—dorsal scales of the upper foreleg.

infrabrachials—ventral scales of the upper foreleg.

prebrachials—anterior scales of the upper foreleg.

postbrachials—posterior scales of the upper foreleg.

supra-antebrachials—dorsal scales of the lower foreleg.

infra-antebrachials—ventral scales of the lower foreleg.

preantebrachials—anterior scales of the lower foreleg.

postantebrachials—posterior scales of the lower foreleg.

supracarpals—dorsal scales of the hand, excluding the digits.

infracarpals—ventral scales of the hand, excluding the digits.

supradigital lamellae—dorsal scales of any digit on hand or foot.

subdigital lamellae—ventral scales of any digit on hand or foot. In most iguanids they bear 3 to 5 keels.

lamellae—when this term is used without specification, *subdigital lamellae* is always implied.

predigitals—anterior scales of any digit on hand or foot. Not present in all lizards.

postdigitals—posterior scales (i.e., those between the rows of supra- and subdigital lamellae) of any digit.

suprafemorals—dorsal scales of the upper hind leg or thigh.

infrafemorals—ventral scales of the upper hind leg; in those species with femoral pores, as far posterior as the pore series.

prefemorals—anterior scales of the upper hind leg.

postfemorals—posterior scales of the upper hind leg. Frequently very different in character from other thigh, femoral, scales.

supratibials—dorsal scales of the lower hind leg or shank.

infratibials—ventral scales of the lower hind leg.

pretibials—anterior scales of the lower hind leg.

posttibials—posterior scales of the lower hind leg.

supratarsals—dorsal scales of the foot excluding the digits.

infratarsals—ventral scales of the foot excluding the digits.

General Features of Scales

carinate—keeled; provided with an elevated, longitudinal, straight ridge, either sharp and well defined or broad and obtuse. Scales may be *unicarinate* (with one keel), *bicarinate* (with two keels), *tricarinate* (with three keels), *quinquecarinate* (with five keels), etc.

denticulate—provided with small, toothlike spines or points. Generally used with reference to the edge of a scale.

granular—small, convex, and not overlapping.

imbricate—overlapping like shingles. The infralabials of *Holbrookia, Uma,* and *Callisaurus,* as well as the superciliaries of many other genera, are said to be imbricate, but in such connection the word does not mean *overlapped* but *diagonal* as opposed to *vertical,* with each scale extending upward and obliquely caudad from the labial border.

mucronate—provided with a *mucrone,* a projecting spine at the free (posterior) *median* tip. Spines at either side of the middle of the posterior edge are *denticules.*

notched—with a sharp median excavation or notch.

pavimentous—large, flat, frequently (but not always) quadrangular, and juxtaposed rather than overlapping.

rugose—rough-surfaced.

striated—with irregular lines of elevation.

Measurements

snout-vent—from the tip of the snout to the anterior margin of the anus.

tail—from the anterior margin of the anus to the tip of the tail. Measurements should be taken only of complete tails except under special circumstances

total length—the combined snout-vent and tail length from tip of snout to tip of tail. Useful only if the tail is complete.

head length—from tip of snout to posterior margin of ear, when present, along a line parallel to the median axis of the head. In the absence of the ear the method of measurement should be specified for each case.

head width—can be taken at several points such as at the temporal or orbital level. If not specified, the greatest width in a straight line is implied.

foreleg—measured from insertion of leg to tip of longest digit, excluding the claw.

hind leg—same as for the foreleg.

axilla-groin—distance in a straight line from the posterior margin of insertion of the foreleg to the anterior margin of the insertion of the hind leg.

limbs adpressed—the hind limb laid forward and the foreleg laid backward along the side of the body; the distance separating the toe and finger tips, or the distance that they overlap, is frequently of significance.

Miscellaneous Definitions

azygous—single, median in position. The rostral, mental, and interparietal, for instance, are always azygous.

anterior—toward the head end (=craniad).

posterior—toward the tail end (=caudad).

dorsal—situated on or pertaining to the upper surface.

ventral—situated on or pertaining to the lower surface.

lateral—lying at or extending toward the side.

median—middle.

proximal—toward the center (i.e., the median axis) of the body.

distal—the opposite of proximal; away from the center of the body.

shoulder patch—a black or very dark triangular marking just in front of the foreleg.

belly patch—an extensive marking on either side of the belly in iguanids (usually in males only). The color varies greatly, but blue is most frequently encountered. Frequently the patches are bordered by a distinctive color.

HABITATS

Practically all kinds of habitats have been invaded by lizards. Exceptions are strictly aquatic, strictly aerial, and arctic environments. Even these are invaded peripherally. The Central American basilisks are confined to stream or lake borders, where they play about in the water and skitter over its surface for all the world like a *Crotaphytus* that rushes over land, using the very long, flailing hind legs for propulsion.

The only marine lizard is one large species in the Galápagos Islands, but even this does not venture more than a few feet from land. Lizards as a whole are not nearly so well adapted to aquatic life as most other reptiles, as for instance the snakes, which have a whole family adapted for life in the ocean, and various other genera suited to aquatic life in fresh water. Yet some of the ancient lizards, the mosasaurs, of which only fossil records remain, were very

well fitted for marine life. The group is now entirely extinct, and no others have yet taken over its habitat.

Our strangest lizards are those that have invaded the subterranean regions. Many representatives of a relatively large number of families have lost or greatly reduced their limbs and have simultaneously adopted a secretive mode of life. Such recourse was a necessity since the usual method of protection employed by other lizards—rapid or agile locomotion—was not for them. Although the external limbs may be absent, at least one limb girdle is represented internally in all lizards. Burrowing lizards may not only lose the limbs, but the eyes and ears may also degenerate almost or quite completely. Presumably from some such a degenerate lizard, far back in geological history, snakes were derived.

The most typical habitat for lizards is the ground. On the ground their well-developed legs, long body, and long tail are useful for rapid movement in seeking protection or capturing prey. Exceptional terrestrial lizards, like horned lizards, are short and squat.

Perhaps second in preference as an abode for lizards is the vertical plane of trees, cliffs, dwellings, etc. Lizards found in such habitats may have suckers or stout claws, instead of the long claws of terrestrial lizards, to enable them to cling to the surfaces. In some the protective coloration becomes extremely effective. A flattened body is of frequent occurrence.

In any one area various species usually occupy several of the major habitats mentioned above; and where many occur in a restricted area, each usually has a particular niche which it occupies to the exclusion of all others. Where different niches are abundant and other conditions are favorable, twenty or thirty species may occur in one small geographic area and be so abundant that they are visible on all sides. In other areas where conditions are less favorable, lizards may be rare and difficult to find. As a general rule the farther north or the higher one goes, the less abundant species or individuals become.

The factors included in the choice of a precise habitat are very numerous. Maximum temperature, minimum temperature, average temperature throughout the year or during the breeding period, amount of light, prevailing color, evaporating power of the air, humidity, texture of the soil, availability of shelter and food, quantity and type of vegetation are a few of the more important factors limiting geographic and ecologic distribution. The relative importance of these and other factors is poorly known and probably differs for each species. Stuart (*Utah*), Linsdale (1938, *Nev.*), and Weese (*lit. cit.*) have commented in detail upon some factors.

LIFE HISTORY

Hibernation or quiescence during adverse winter weather occurs in all parts of the United States and Canada, with the possible exception of extreme

southern Florida. The length of the period of quiet and the extent of dormancy depend upon the resistance of the species as well as upon the external conditions. Hibernation is most nearly complete and most protracted toward the north. Complete estivation is not known in American reptiles.

Hibernating lizards may depend upon only a few inches of soil to protect them from the cold above; however, in some parts of the country specimens have been found at depths as great as 8 feet below the surface. The depth to which the animals may go depends upon the species and the ease of penetration as well as the temperature, also upon the age; young specimens remain active longer in the fall than adults and hibernate at shallower depths. The same generalization applies to small species as compared with large. Research on desert reptiles by Cowles involving

96 specimens of 14 species shows that most prefer shallow retreats, the majority lying at less than 13 inches, but with extremes ranging from just below the surface of the ground, where they are sometimes exposed to freezing temperatures, to a possible extreme depth of 30 inches, where the temperatures are relatively equable. The average temperature of the reptiles taken in hibernation was 16.1° C., with the adjacent soil 15.2° C. The difference of 0.9° C. may indicate some generation of body heat, but it is believed that the data here used are insufficient to justify this conclusion. At present the chief significance of these averages should be the degree of accuracy indicated in identifying the depth of hibernation by a comparison of the body temperatures of freshly excavated individuals with that of soil. The minimum temperature actually recorded on a specimen was 13° C., but soil temperatures are known to reach much lower levels during ordinary years, so that lizards hibernating even at depths of 6 inches are subjected to 4° C., and in exceptional years even lower. The maximum observed was 20° C., found in an individual resting 4 inches below the surface, but again it is known that those taken at the 1- and 2-inch levels are often exposed to higher temperatures during the hibernating season. The probable range of temperatures under which hibernation may continue under ordinary circumstances may therefore be stated as lying between 0° C. and 20° C.; the shallower hibernating forms, such as the young and occasional adults, will therefore survive these fluctuations.

Although even the shallower retreats offer considerable protection from extremes of cold, it is clear that thermal protection alone is not the only factor involved in the selection of the hibernation site. Danger from predation is probably as important a factor as shelter.

The young of most species of desert reptiles remain active later in the season than do the adults, one of the important reasons being the effective heating of these small bodies in favorable periods which are apparently too brief for utilization by the adults—the long, almost continuous activity of the smallest species of lizards being due in part at least to this factor (1941, *lit. cit.*).

Upon emergence from hibernation adults feed for a week or two, and enter upon a courtship and mating period that may last several days. The courtship pattern varies from group, or family to group and has considerable phylo-

genetic constancy. On the basis of experiments and field observations Noble and Bradley concluded that "the mating behavior develops spontaneously in males and is directed toward other individuals regardless of sex. Male lizards of most species fight during the breeding season, and this response of the male, when approached by another lizard, forms the basis of sex discrimination" (*lit. cit.*). Other authors, solely on the basis of field notes, maintain that sex recognition is accomplished also on the basis of pattern differences. The point is in need of further study. Copulation in lizards is generally effected while the male grasps one side of the female's neck in his jaws. Venters are never opposed.

The bright colors which adorn many male lizards do not serve as attracting devices as has been assumed hitherto. Neither females nor males are attracted by the displays. Bright colors have the important function of aiding in sham fights when the males attempt to avoid combat with rivals by making themselves appear as large and conspicuous as possible. The greatest displays of color are directed toward rival males, and not toward females.

Since male lizards of most species fight during the breeding season, lizards tend to live in definite territories during that season at least. Bright colors have aided in the maintaining of territory against rival males.

Lizards which practice the same type of mating performance may have strikingly different hemipenes. The species, however, that have the more complex performances have the more modified hemipenes (Noble and Bradley, *lit. cit.*, pp. 94–95).

Not long after mating, the eggs, which vary from 1 to about 25 in number, are laid in various situations according to species and hatch in late summer or early fall. The eggs of most lizards increase markedly in size during development of the embryos, enlarging to about one and one-half times the original size. The hard-shelled gecko eggs, however, do not change in size after deposition. Some lizards "brood," i.e., they remain in the nest where the eggs are located until they hatch. Hatching occurs sufficiently in advance of the period of hibernation to allow for a moderate growth. An egg tooth, said to be double in some geckos but absent in others, aids in breaking the shell when the embryo is ready to emerge. These teeth are shed shortly after birth. The eggs are usually leathery-shelled, but those of geckos are brittle-shelled.

Some lizards do not lay the eggs at the usual time but retain them within the body until the young are ready for birth. Some are always live-bearing, and a very few others may either lay eggs that hatch within a few days or hours, or they may give birth to the young. One southern European species is live-bearing in lowlands, egg-laying at higher altitudes. In general the live-bearing habit is correlated with low temperatures during the period of activity; thus in many areas one can predict that the higher the elevation or the more northern the latitude, the greater will be the proportion of live-bearing species. There are of course many exceptions, either as egg-bearing species

living at low temperatures or as live-bearing species living in warm regions. The latter may be explained as having been derived from stock formerly restricted to colder areas. Egg-laying species are termed *oviparous,* and it has been customary to call reptilian and other cold-blooded live-bearing species *ovoviviparous*. The term *viviparous* is customarily restricted to the usual mammalian condition in which a placenta occurs. Actually a placenta occurs in at least some live-bearing lizards, so the presumed distinction between ovoviviparity and viviparity loses its significance. The distinction can be made, but it must be understood as an arbitrary one.

Viviparity occurs, among American lizards, in some species of *Sceloporus* and *Phrynosoma,* and in all xantusiids.

The breeding habits and rates of growth are very poorly known for most lizards of this country, and offer highly profitable fields for experiment and observation. Several brief accounts of various species have appeared, but the most complete and accurate studies are two: one by Fitch (*lit. cit.*) on *Sceloporus occidentalis* and another by Rodgers and Memmler (*lit. cit.*) on *Eumeces skiltonianus*. These are model field studies which may well serve as patterns for the future studies so sorely needed on other species. It is remarkable that the growth rate, age of maturity, and maximum age should be so similar in groups as remotely related as *Eumeces* and *Sceloporus*. Both species studied, however, are of moderate size. Small species such as *Leiolopisma*, large species such as *Ctenosaura* and *Sauromalus,* and burrowing species such as *Rhineura* may have widely different modes of growth. So far as is known, however, growth ceases during the first hibernation period of the newly born, or hatched, young and is resumed apace the second year. By the third year most lizards have reached adult size; they then grow very much more slowly than before. Breeding occurs during the third and subsequent years in most species.

Most United States lizards reach a maximum age at about eight or nine years. Very few exact records have been kept.

Young lizards have disproportionately large heads and long limbs, which grow less rapidly than the body as the lizards reach adult size. Certain scales on the head, particularly the interparietal, are extremely large in young specimens.

HABITS

FOOD

Most lizards are insectivorous. A few (some species of *Sceloporus*) are omnivorous and a few others (*Sauromalus, Dipsosaurus,* and *Ctenosaura*) are completely herbivorous. Some prey on lizards of their own or other species. Carnivorous species distinguish their food by its movement or, if it is stationary, by its "taste," testing it first with the tongue and then with Jacobson's

organ. Some insects are distasteful and are rejected after ingestion; if encountered frequently lizards learn to disregard them upon sight.

TIME OF ACTIVITY

Most lizards are diurnal, and during the night, late evening, and early morning remain hidden in holes and cracks, under objects, etc. They may not emerge at all on cool or cloudy days. In desert and subtropical regions, however, where at least the early part of night is warm, nocturnal species are not uncommon. In the United States the geckos, xantusiids, and *Heloderma* are night wanderers. The last-named appears to be most commonly encountered near dusk, and it is for this reason termed *crepuscular*. Even strictly nocturnal species do not remain active all night, but usually become sluggish three or four hours after sunset or about eleven o'clock.

Diurnal species are not equally alert throughout the day, but reach a peak of activity in the morning around ten or eleven o'clock. During the middle of the day they may seldom be seen, but around four o'clock they again emerge, although they do not reach the same degree of activity as in the morning. This rhythm is most prominent in desert species, which are subjected to temperatures above optimum limits. More northern species tend to be active throughout the warm parts of the day. Of the less conspicuous diurnal lizards like skinks, little can be said concerning the rhythm of activity. In fact the time of animation, whether night or day, is not well established for some lizards. The strictly burrowing lizards, of course, do not often emerge at any time; whether their subterranean activity rhythm is correlated with night and day is not known.

TEMPERATURE REGULATION

In recent years the toleration of heat by desert reptiles has attracted much attention; noteworthy students have been Cowles and Mosauer. For a summary of literature and present knowledge see Cowles and Bogert (*lit. cit.*). As is well known, reptiles are largely dependent upon external sources of heat to maintain proper average body temperatures; they are, in other words, ectothermic. In addition they are poikilothermic, or variable in body temperature, since they must and do vary in temperature pretty much as their environment, and the variation in deserts, for instance, where lizards are common, is very great throughout the day. Fishes, like reptiles, are ectothermic, but most (there are exceptions) are not poikilothermic, since they show little tolerance to variation in water temperatures; fortunately water is notably stable in temperature. Both fishes and reptiles, as well as the other "lower" vertebrates, are to be distinguished from the endothermic animals, birds and mammals. The latter are generally termed homiothermic, whereas all "lower" vertebrates are considered poikilothermic, but the distinction implied by the meaning of the words does not really exist; literally the term homiothermic

applies most accurately to fishes and poikilothermic to amphibians and reptiles; mammals are both. Thus the distinction that was intended by the use of these terms is more appropriately expressed by the term ectothermic for "lower" vertebrates and endothermic for birds and mammals.[4]

It is a popular belief that reptiles in general and lizards in particular can stand temperatures far higher than those tolerated by other animals. This belief is founded partly upon the common experience of seeing lizards basking in the open sun on very hot days in deserts in various parts of the world. The assumption is generally made that the lizards remain in the open for hours at a time, and the observer's amazement knows no bounds if he takes the trouble of feeling the rocks on which the lizards have been sunning; frequently they are so hot the hand cannot be held on them for more than a few seconds.

Thus incomplete observation and unwarranted assumption combine to give rise to an incorrect but deeply rooted idea that desert reptiles can stand great extremes of temperature. Actually the limit of toleration is much the same as for all other animals; that is, for protoplasm in general. The lizards most perfectly adapted to high temperatures die when the body reaches about 45° C., and this is the temperature at which practically all animals die. In other words it is not the upper limit of toleration that is so remarkable in some lizards, but rather the average body temperature which the animal finds most favorable for its particular way of living. This is the optimum temperature. For some desert lizards it is as high as 40° C., only a very few degrees from the lethal temperature; for others the optimum temperatures are considerably less, probably approaching those of the nocturnal snakes (32° C.). It must be mentioned that Herter (*lit. cit.*) records an Egyptian lizard with an optimum temperature of 45.6°C., higher by about five degrees than the record for American lizards. He brings out the fact that the optimum temperature for any species varies directly with the climate in a rough way (presumably the average temperature of the period between hibernation). This is evident in wide-ranging species, the southern specimens having a higher optimum than northern ones, and in species with considerable vertical range, as the lower level populations have a higher optimum than the higher level populations.

Since the environment of lizards shows a greater range of temperature than the animals can tolerate, some means of adjustment has been a necessity. One means, the simplest, involves retirement into crevices in rocks or under the surface of the ground to avoid the direct rays of the sun or high or low air temperatures. Another means, not now of major importance, was developed in ancient geological times; that was to increase the bulk of the body. Obviously it takes longer to heat up a large body, or to cool it off to a fatal degree,

[4] For a further discussion of this and related topics, see Raymond B. Cowles, 1940, *lit. cit.*

than it does a small mass. Although this was a factor perhaps in the huge size increases of the gigantic reptiles of the past, it did not preserve them from complete extinction. Their smaller relatives, however, developed the ability to control temperature by color changes, and in some modern lizards this ability is very highly developed. The absence of such an ability in snakes is a direct reflection of their descent from burrowing lizards which, of course, had lost the need for and presence of color control.

Most lizards, as indicated by the work of Atsatt (*lit. cit.*), become dark at low temperatures, light at high temperatures. Their color regulation is to prevent overheating, since maximum heat absorption occurs in the presence of a uniform pigment (dark color) such as was found in primitive reptiles lacking control of color. Thus in such lizards regulation of overcooling is accomplished simply by retiring to depths at which freezing temperatures are not reached or are but little surpassed. An exception to this rule is shown by *Xantusia vigilis*, which becomes dark at high temperatures, light at low temperatures. Cowles (1940, *lit. cit.*) ingeniously suggests that the reason for this reversal is that the main concern of this *Xantusia* is to get warm enough, not to prevent getting too warm; its habits support this premise.

Although color change probably originated as a method of heat control, in some lizards it has taken on other functions and responds to emotional states as well as to temperature.

Not only have lizards developed the ability of changing pattern to combat the problems of heat control, but through the ages those diurnal species or sub-species that occur in sandy deserts have become light in color, while desert rock dwellers, even of closely related forms, are relatively dark. Many examples could be cited to illustrate this generalization. Light-colored diurnal sand dwellers include *Dipsosaurus*, *Uma*, *Callisaurus*, and *Phrynosoma m'callii*.

There are others, not exclusively desert dwellers, which are lighter in the desert area than elsewhere in their ranges, such as [*Gambelia*] *wislizenii* and *Uta stansburiana*. In the category of rock-dwellers we have the following diurnal lizards: *Crotaphytus collaris*, *Sauromalus obesus*, [*Streptosaurus*] *mearnsi*, [*Urosaurus*] *microscutatus*, [*Urosaurus*] *ornatus symmetricus*, and *Sceloporus magister*. Making allowances for territorial differences, and the power of individual color change which many lizards possess, it can be said that these forms, on the average, are definitely darker than the sand-dwellers, and some are very dark (Klauber, *Ariz.*).

Temperatures in deserts such as those of our Southwest daily reach levels intolerable, except in winter, for lizards or any other living creatures; fortunately such temperatures are not ubiquitous. A few inches underground, in rock crevices, in shade, etc., temperatures remain within tolerable extremes. Thus all diurnal desert species must either alternate short forays into the open with cooling-off periods in the shade, or else must limit their activities to the cooler parts of the day, morning and evening. This applies both to rock and

to sand dwellers; yet, as mentioned above, the problem is met by one with a dark color, by the other with a light color. This seeming discrepancy has been the source of some speculation, particularly by Parker (1935, *lit. cit.*) and Klauber (pp. 65–79, *Ariz.*). Parker presented the theory that, where lizards are subjected to extremely high temperatures, as in many deserts or in hot, tropical, rain forests, and where they can escape from the sun, as by seeking crevices, a dark coloration "bestows a definite advantage upon its possessor; the better heat dissipating properties of a dark surface as compared with a light one assist the animal in maintaining its temperature below that of its surroundings. . . . In sandy deserts it (melanism) has no particular advantage, and in warm regions clothed with vegetation, but with a relatively dry atmosphere, it is probably disadvantageous." This is a version of what might be called the theory of thermostatic coloration, which, in brief, holds that radiation and reflection phenomena in some areas are the chief factors in determining patterns. In the present case the theory assumes that protective radiation through dark patterns adapts for one environment and that protective reflection through light patterns adapts for another. The theory fits with a physiology which demands a fair degree of activity throughout the day, allowing many short forays but no, or few, long ones, for "while the dark lizard will be benefitted by cooling faster after his foray, he will also be penalized by heating faster during his venture into the sun, which quite counterbalances the supposed advantage [of quick cooling]" (Klauber).

A closer examination of the question by Klauber, however, revealed that most United States desert animals with dark patterns are not particularly benefited thermally by their color, and that the same is true of light-colored desert animals. In the first place, our own desert lizards at least do not exist by the foray method; they very definitely emerge in the morning in great abundance, disappear during the middle of the day, and reappear, in lesser abundance, toward the end of the day. In the second place, rock and sand dwellers actually are in the same situation with regard to protective radiation, for the latter retire to holes in the ground, an exact thermal parallel of the crevices sought by the rock dwellers. Thus even if our lizards did live by the foray method, the retreats of rock and sand dwellers are so similar thermally that they should similarly result in dark patterns. Only if they lived by the foray method, and the sand dwellers sought retreat largely by diving into the sand, would the facts fit Parker's theory. Klauber minimizes the importance of the theory of thermostatic coloration compared with that of protective coloration, concluding that the solution is not at all in a difference in thermostatic adaptation but rather in concealing coloration. "In some situations protective coloration and protective reflectivity work to the same end; where the two would tend to produce opposite results, protective coloration seems to be controlling." The topic is discussed in full in Klauber's essay.

Some observers have come to the conclusion that lizards slow down con-

duction into their bodies of the heat of the objects on which they rest by elevating the bodies and supporting themselves by the digits. Mosauer (*Calif.*) argues contrariwise, suggesting that the feet are the most sensitive portions of the ventral surfaces of the animals, and that when the substratum becomes somewhat too hot the lizard rests his belly on the rock and lifts up the tender feet. He believes the elevated body position is assumed for the purpose of better observation, not for heat avoidance.

Many desert reptiles never drink but acquire their necessary water directly from, or by chemical changes of, the food eaten. This is not the case in most nondesert lizards, however, which must have water more or less regularly. Some refuse water from dishes or other containers and take only droplets, as of dew, scattered about on foliage or other substratum. At any rate the drinking of water does not aid in the regulation of body temperature either directly or by stimulating sweating, since reptiles cannot sweat and desert reptiles do not drink anyway.

Some reptiles have a black peritoneum, whereas others have one of a silvery color. Whether this difference is associated with temperature control is not clear. Klauber (p. 76, *Ariz.*) believes it a "second line of defense" against deleterious rays that penetrate the outer defense layer of skin pigment, transforming them into heat rays, which can be dissipated harmlessly.

COLOR PATTERN

Many lizards have different juvenile and adult patterns. Commonly the young have the more brilliant markings. In skinks generally the markings are more brilliant in the young, particularly on the tail, which may be bright blue or pinkish but turn a dull blue-gray or brownish in adults. Some juveniles are so different from the adults that for years they were thought to be a different species (e.g., *Eumeces obsoletus* and "*E. guttulatus*"). In *Coleonyx* the young are strongly cross-banded, the adults mottled; in *Ctenosaura* the young are a uniform green, the adults multicolored but with no bold pattern; the five-lined skinks tend to lose the stripes by gradual disappearance in adults; *Eumeces obsoletus* is black in the juvenile stage, mottled in the adult; several *Cnemidophorus* species are striped in the young, mottled or cross-barred in the adult, and all the young are brightly blue-tailed.

Bright nuptial colors may be assumed by certain lizards, generally by the males. In many genera of iguanids the sides of the ventral surfaces of the belly are often brightly colored, generally with blue tones, while females show little evidence of such markings. Cnemidophori males also have a more brilliant ventral coloration than the females, but this amounts mainly to a pinkish throat and an intensification of the mottled belly pattern. In general the brighter markings of males are simply intensifications of the colors of a basic pattern evident in both sexes.

The chief use for these bold markings is not, as has been held by many ob-

servers in the past, to attract the females, but rather to send other competitors or enemies away. Males typically expose their full size and display as much as possible of their bright colors upon sighting other males; females elicit different reactions. It is clear that males of species in which a marked sexual dimorphism in pattern occurs can distinguish sex by pattern and color; thus sight is the most important sense in this regard. Lizards with no marked differences between the sexes in color or pattern cannot utilize sight. The sexes are distinguished during the mating season by their reactions to each other; females are more or less docile when approached by other lizards (and only males actively seek the company of others), whereas males are belligerent.

The colors of lizards are due partly to the presence in the outer layer of the dermis of the skin of cells (chromatophores) provided with pigment granules or masses and of oil droplets. In certain species the color may be due in part to a peculiar, iridescent substance (guanin) carried within certain other cells (iridocytes) of the dermis. Finally, the color may in some species be influenced by the mechanical structure of the surface of the scales. Of chief importance in lizards which can change their color are the chromatophores and oil droplets. In all lizards the only changeable elements in the color-effecting system are the melanophores (the chromatophores provided with melanin, a dark brown, nearly black pigment). Even the famous chameleon of the Easttern Hemisphere has no more varied a medium of variation than any poikilochromic (color-changing) United States species. The following detailed description of the skin of *Anolis carolinensis* explains more clearly the exact relationships of the several components:

The epidermis is a transparent area, typically divisible into the stratum corneum and stratum germinativum. Just beneath the epidermis is a layer of yellow oil droplets and xanthophores. . . . Internal to the oil droplet layer lies a much thicker region known as the leucophore layer; this is composed of a number of irregularly spaced blocks or plates, the long axes of which are parallel to each other. . . .

Below the leucophore layer are situated the melanophores, which are the cells actively concerned in the color changes of *Anolis*. The cell bodies of the melanophores lie imbedded partly in the leucophore layer and partly in the deeper connective tissue of the dermis. A varying number of branches, extending vertically upward from the cell bodies of the melanophores pass through the interstices of the leucophore layer and are subdivided into many finer branches which terminate beneath the inner surface of the epidermis.

When the skin is in the brown state the pigment granules are dispersed through the fine terminal branches of the melanophores, resulting in a layer of pigment just beneath the epidermis. In the green phase of skin colour the pigment is present only in the proximal portions of the branches, having been withdrawn from beneath the epidermis. The finer distal branches are practically transparent except for a few scattered granules which may have failed to migrate proximally within the main mass of the pigment.

It is evident that the melanophores are the cells actively concerned in the various

colour phases of *Anolis*. The other components of the skin, namely the oil droplets, the xanthophores and the leucophore layer, play a passive or at most a very restricted part in metachrosis, acting as filters or reflectors (Kleinholz, 1938, pp. 477–478, *lit. cit.*).

The melanophores effect an astonishing amount of variation in the color of a lizard merely by their own activities, which are limited to dispersion or concentration of their pigment. Sometimes a melanophore is so situated that its pigment in the dispersed state conceals or obscures some other stationary chromatophore or iridocyte which is otherwise in full view.

In general eight factors control the color of a lizard: its ontogenetic stage (whether young or adult), its sex, the color of its environment, the season, the temperature, its state of excitation, its health or physical state, and the light. The first four factors are not environmental, except in a very broad sense, or if so do not change, but the last four definitely are changeable environmental factors, and these are the ones which bring about the rapid color changes one ordinarily observes in lizards. Least known of all are the effects of excitation and health. Atsatt (*lit. cit.*) concludes: "In analyzing the experimental responses to *illumination* one finds that: (1) the response to sunlight is more complete than to artificial light, (2) the response to artificial light is proportional to the amount of light, (3) the response is rapid, (4) the speed of the response is controlled by the temperature, (5) the response is lost at a definite temperature, and (6) the response betrays no sign of fatigue in the animal." Unless the background is white, if illumination produces any effect at all, it is a darkening. On a white background the change, if any, is generally a paling.

"An analysis of the responses to *temperature* show that: (1) low temperature causes darkening in iguanids, (2) high temperature causes paling in iguanids but darkening in xantusiids, (3) temperature responses are slower than illumination responses, and (4) low temperature may interfere with response to excitement" (Atsatt). It is noteworthy that while there is a fairly consistent reaction to temperature changes, illumination changes produce a varied reaction, some species showing a marked reaction, others not.

Color changes (metachrosis) due to changing environmental conditions are well known in many lizards and in America are best exhibited by the anoles (see discussion of *Anolis carolinensis*). Not all lizards are capable of such color changes, however. It is a remarkable fact that the ability is restricted to the more primitive families: it occurs in the geckonids, iguanids, and xantusiids, whereas the color of skinks, lacertids, teiids, amphisbaenids, anguids, helodermatids, and anniellids is quite or nearly constant under all environmental conditions and changes only with radical hormonal alterations, becoming evident after ecdysis takes place, as in snakes.

Experiments on *Phrynosoma* and *Anolis* show that the parietal eye in these lizards at least plays no part in light perception for color change.

The intrinsic mechanisms whereby reactions of melanophores to variations

in temperature, excitation, physical state, and light are mediated are numerous and complicated. There is some variation in the number of mechanisms in lizards, but they are not as complicated as in many fishes. Temperature presumably affects the melanophores directly without intervention of nerves or hormones. States of excitation and health affect the melanophores through the medium of hormones. Light, on the other hand, can effect changes either by direct action or by means of intermediary hormones.

Three hormones are important in affecting melanophores. They are (1) intermedin, produced by the pituitary gland; (2) acetylcholine, produced at the end plates as well as at the synapses of certain nerve fibers ("dispersing" fibers only) at the point of contact with the melanophores; and (3) adrenalin, produced by the cortex of the adrenal gland or by the end plates of certain nerve fibers ("concentrating" fibers only) at the point of contact with the melanophores or (?) by the pituitary gland (? W-substance). No inherent distinction between various environmental factors, such as light, health, etc., is evident in the hormones they may bring into play, but excitation in lizards perhaps produces an effect largely by means of adrenalin. In anoles pinching or other mechanical stimulation, or the excitement of mating activities causes a mottled pattern which is due apparently to stimulation of the adrenal glands and to the subsequent action of the adrenalin secreted. Aside from this possible exception, any of the three hormones may be involved. The first two, intermedin and acetylcholine, always produce the dispersed phase of the melanophores, whereas adrenalin always produces the concentrated phase.

The changes contingent upon variation of light are most difficult of all to understand because of their complexity. The pattern of reflexes varies in different species, probably within even a single genus. Early embryos of all vertebrates pass through a stage in which the melanophores are affected directly by light, contracting in darkness, expanding in light. This, the primary stage, is modified in late embryos and throughout subsequent life, under ordinary conditions, by a secondary stage, in which there is no direct action of light upon melanophores. Sometimes the primary stage is of very brief duration, but in some amphibians, such as *Ambystoma tigrinum,* it is extended throughout life. It is now thought that the primary stage does not occur in reptiles postembryonically,[5] but it is well to keep the possibility of its occurrence in mind, and to realize that in darkness or in the event of removal of the elements involved in the secondary stage, primary responses may be expected. Isolated skin does show primary responses, but intact skin does not, except as mentioned above.

All adult lizards presumably are in the secondary stage. In them the dark color phase is produced by light only (never in darkness), received either by

[5] In 1938 Parker (*lit. cit.*) argued at length that melanophores normally reacted directly to light as well as to hormones, but in 1943, perhaps because of the work of Kleinholz (1938, pp. 492–499, *lit. cit.*), his opinion was reversed (pp. 207–209, 215, *lit. cit.*)

the eye or the skin. Receptors in the skin, the nature of which is unknown, direct impulses to the pituitary gland, causing secretion of intermedin. Receptors of the eye can do the same thing or can direct impulses along "dispersing" nerves, whose end plates secrete acetylcholine. Unless the eye receives light from a very light or white background or unless it receives green light (in *Anolis* at least), the eye always responds to light with a darkening of the skin (within the limits of other factors such as temperature).

The light color phase is produced only in darkness, presumably by a direct response of the melanophores, and under certain conditions, such as a green

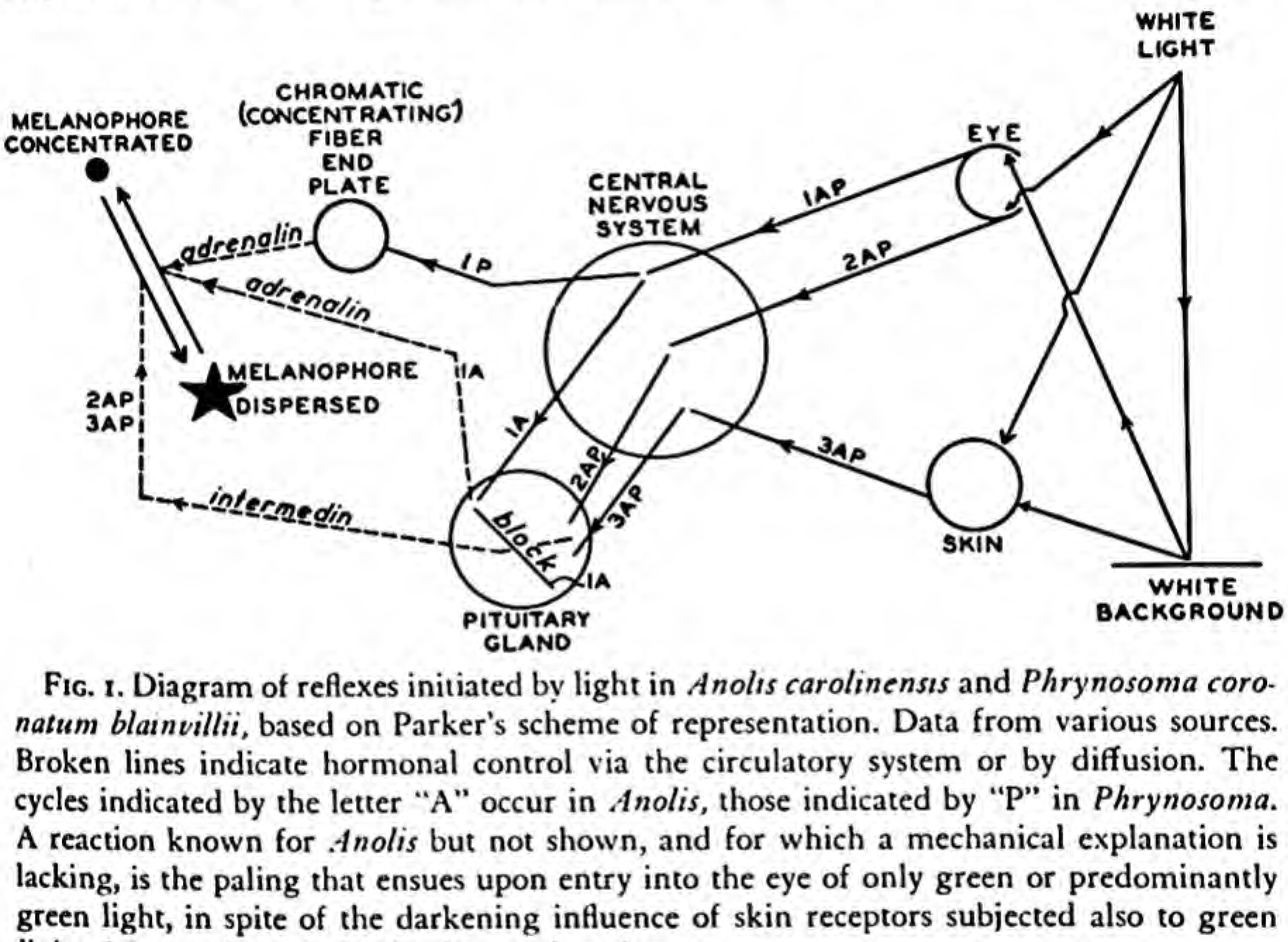


FIG. 1. Diagram of reflexes initiated by light in *Anolis carolinensis* and *Phrynosoma coronatum blainvillii*, based on Parker's scheme of representation. Data from various sources. Broken lines indicate hormonal control via the circulatory system or by diffusion. The cycles indicated by the letter "A" occur in *Anolis*, those indicated by "P" in *Phrynosoma*. A reaction known for *Anolis* but not shown, and for which a mechanical explanation is lacking, is the paling that ensues upon entry into the eye of only green or predominantly green light, in spite of the darkening influence of skin receptors subjected also to green light. See text (p. 44) for further explanation.

light or a white or light background, when light is received by the eye. The light phase is never produced in the presence of light except as the eyes are properly stimulated; there is no similar effect produced by light received by the skin only. The eyes can bring about their effect by causing "concentrating" nerves to stimulate the secretion of adrenalin from their end plates; they can cause the pituitary gland to secrete adrenalin; or they can inhibit the secretion of intermedin by the pituitary gland.

Color changes are further complicated by the fact that some lizard species, chameleons, have melanophores provided with both dispersing and concentrating nerve fibers; others, *Phrynosoma,* have them provided with only concentrating nerve fibers; while others such as the anoles have no fibers whatever connected with the melanophores. Very few species, however, have

been investigated in this respect; whether there is any evolutionary trend in the variation is not now apparent. In fact, the generalizations on the entire subject of metachrosis in lizards are based upon so few experiments and upon so few species that many changes may be expected in our understanding of the many phenomena involved. It is an "inviting field for adventure and research." The physiological effects have been studied in detail only in *Anolis carolinensis, Phrynosoma cornutum,* and *P. blainvillii,* among American lizards, and Atsatt's work (*lit. cit.*) is the only supplementary study of significance on other species. The effect of a white versus a black background on color needs investigation in species other than *Anolis* and *P. cornutum,* for which there is ample evidence of an antagonistic affect. Parker (1943, p. 222, *lit. cit.*) considers that only one reflex cycle is present in *Anolis,* but there is ample proof that at least three (Fig. 1) and possibly four exist.

In *Anolis,* as shown in Fig. 1, the light received directly by the eye (cycle 2AP) causes impulses to be sent along nerves to the central nervous system and thence to the pituitary gland, which is stimulated to secrete intermedin. The latter is carried by the circulatory system to the melanophores, which are caused by the hormone to assume the dispersed phase. Light received by the skin follows much the same pattern (cycle 3AP), causing impulses to pass along nerves to the central nervous system, which relays impulses along other nerves to the pituitary, with the same result as in cycle 2AP. However, if the eye receives light from a very light background, impulses relayed (cycle 1A) to the pituitary block production of intermedin and simultaneously stimulate secretion of "W-substance" (= adrenalin?) by the pituitary. The latter hormone, carried by the circulatory system to the melanophores, causes them to assume the concentrated phase.

In *Phrynosoma* concentrating fibers are present, although they are absent in *Anolis.* They conduct impulses relayed from the retina upon stimulation by light from a very light background, and these impulses in turn cause secretion of adrenalin from the end plate of the concentrating fiber. The hormone diffuses an infinitesimally small distance to the melanophore, against which the end plate lies, and produces a concentrated phase of the melanophore. Whether cycle 1A as shown for *Anolis* also exists in *Phrynosoma,* supplementing the action of cycle 1P, is not known.

Contrary to frequent belief, the skin receptors can only cause darkening; blinded animals do not react to the color of the background.

References and further discussion on this topic will be found in Walls (pp. 538–543), Parker (1938 and 1943), Kleinholz (1938, pp. 474–490), and Redfield (all in *lit. cit.*).

LOCOMOTION

Most lizards use both legs in locomotion. Elongate species move the body sinuously as the legs move. but the body movement does not of itself aid in

locomotion. No species with well-developed legs fails to use these appendages to full advantage. Certain ones such as *Neoseps* have degenerate limbs and move in a serpentine fashion, while holding the limbs against the body. Those species without limbs move exclusively in a snakelike fashion.

Among the special habits of species with well-developed legs perhaps the most interesting is that of running on the hind legs only, lifting the forequarters high into the air. This habit is most easily observed in collared lizards, because of their large size and relatively slow speed, but many others practice it on occasion. Basilisks do the same trick on water, running over the surface by flailing it with their long hind legs. Our fastest lizards are, presumably, those of *Callisaurus,* which can reach a speed estimated at 90 feet in 4 seconds (= 15 miles an hour). A probably less accurate measurement of the speed obtained by *Cnemidophorus sexlineatus* was figured at 18 miles an hour. This is distinctly less than the fastest speed of man, according to 100-yard-dash records, which is equivalent to 21.7 miles an hour.

Most if not all lizards can swim, although none are as completely aquatic in habits as many snakes. They swim by undulating the body, keeping the limbs against the sides. Some sand-living species, such as *Uma,* are said to swim under the surface of the sand, folding the limbs back just as though swimming under water.

Climbing lizards in this country have claws and adhesive pads. None have grasping digits or notably prehensile tails.

No flying lizards occur in the Americas, although in the Orient many species of parachuting lizards such as those of *Draco* occur.

BOBBING

A peculiar movement restricted largely to iguanids is that of bobbing up and down. Even after one becomes accustomed to seeing little lizards like *Uta* or *Anolis* bob pertly from their perches, it is surprising to see such huge lizards as *Ctenosaura* or *Iguana* ponderously pumping away on top of a rock or on a stout tree limb. The comparison is ludicrous, and the constancy of such a minor habit throughout most of the members of such a large family is the more striking. Its exact purpose is not apparent, although it obviously is correlated with a nervous alertness. It may be suggested that it is a habit left over from the time when the gular fans of lizards were more highly developed than they are now. Only in *Anolis* is the throat fan now highly developed, and in this genus the bobbing serves the important function of lifting the body so that the fan can be fully expanded and of aiding in its display. Since *Anolis* is considered a primitive genus and since many other iguanids have vestigial fans, it is not unreasonable to assume that the bobbing habit developed with the throat fan. The behavior mechanism apparently remains as a testimony of the former existence of a structure now scarcely evident; that a nervous reflex can have greater tenacity in survival than the structures

with which it was primitively correlated is of considerable interest. It is noteworthy that the same situations call forth bobbing in the fanless iguanids that stimulate fan erection as well as bobbing in anoles.

BURROWING

A rather large proportion of our lizards show some propensity for burrowing. The subterranean habit is not limited to one family or even a particular group but is distributed erratically throughout the entire suborder. Reduction of limbs and sense organs and adoption of a wormlike form and a pointed or shovel-shaped snout are trends of adaptation to which the underground life leads, or vice versa. Of our American lizards *Rhineura* is undoubtedly the most highly adapted, having lost its limbs, ear openings, and eyes, and having developed a remarkably wormlike form. *Anniella* is but little less modified; it retains eye openings. *Ophisaurus* has lost its limbs, but the chief cranial sense organs are rather well developed. *Neoseps* in some ways—i.e., in the form of its snout, its flattened venter, and the absence of ear openings—is more highly adapted to a subterranean life than *Ophisaurus,* but very small limbs are still present. These are the most highly modified burrowers, and they represent four different families. Certain other species, such as *Leiolopisma* and *Gerrhonotus l. infernalis,* have remarkably reduced limbs that may be a prelude to burrowing habits, although the animals show no special inclinations to burrow at present.

There are several other groups, however, that have prominent burrowing proclivities but no adaptations for them such as have just been mentioned. These are for the most part sand dwellers, and they include *Holbrookia, Callisaurus,* and *Uma* as particularly noteworthy burrowers, and as less prominent ones the horned lizards, *Phrynosoma.* All these genera typically hide under the surface of the sand at night or for diurnal protection; *Callisaurus* is even said to be able to "swim" under loose sand. Various modifications in the form of fringes are an adaptation to burrowing, and in addition some of these genera have remarkably well-developed, shovel-shaped snouts with countersunk lower jaws.

The burrowing habit of lizards undoubtedly is closely correlated with the necessity of constructing a burrow for the eggs. Almost all lizards construct burrows for this purpose (a notable exception is the primitive family of geckos), and from this the extension of the habit for other purposes no doubt stems.

Perhaps of considerable importance to lizards as a whole, because of their dependence upon some sort of burrowing ability, is the existence of a mechanism for closing the nostrils by means of expanding the walls of the nasal cavity through increased blood pressure (see p. 6). The special adaptation of the nasal region in *Uma* is discussed in detail by Stebbins (1943, *lit. cit.*).

PROTECTIVE REACTIONS

Lizards protect themselves in many ways. Among the active means at their disposal one of the most interesting is that of venomousness. This is possessed only by two species of *Heloderma*, only one of which is found in the United States (see p. 471). Another curious habit, perhaps defensive, is that of blood ejection from the eyes in horned lizards (see p. 7). Many species bite viciously and will charge intruders if aroused and cornered; *Crotaphytus* is an example. Many will scratch, but only large species have claws sufficiently large to injure humans. Ctenosaurs can scratch deeply. Some slash their tails about like whips, and when spiny-tailed species like the false iguanas adopt this tactic, the results can be very painful. Horned lizards can and do give reason for profanity by elevating their heads when picked up, forcing their long, sharp, occipital horns into fingers that may be nearby. Another reaction of horned lizards is to inflate the body, presumably to render their swallowing by snakes more difficult. Horned lizards are not alone in resorting to inflation as a means of protection, however; it is a habit characteristic also of species which take refuge in crevices in rocks and under bark. Chuckwallas and *Sceloporus poinsettii* are familiar examples. The inflation seems to be accomplished by a rapid swallowing of air (see description under *Sauromalus*) by a process similar to that employed by toads. Many species open the mouth and hiss when disturbed; this is most frequently observed in *Gerrhonotus, Phrynosoma,* and *Crotaphytus*—all rather clumsy or slow-moving species.

The most typical recourse of terrestrial lizards when threatened with danger is an exit from the scene by running as fast as they can. Some promptly hide in holes or cracks. Arboreal species may run but short distances; frequently they are adept at keeping the trunk between the intruder and themselves, meanwhile climbing higher and higher. Both terrestrial and arboreal species may "freeze" in their positions and attempt to escape notice by their inconspicuousness. Some species are colored and marked so much like their usual background that they can be discerned only by careful scrutiny.

Among other passive means of protection may be mentioned that of "playing 'possum,'" as practiced by many lizards that have been captured. They appear to be dead and then suddenly "come to life" with a burst of energy that will result in their freedom unless the captor is aware of the trick. Some lizards squeak feebly when injured or frightened; this may be of some protective value. The horns of horned lizards may be of some passive protective value since snakes and other predators find difficulty in swallowing them; and if the feat is accomplished, it may be a fatal achievement since the horns can and do at times pierce the wall of the alimentary tract, even reaching the exterior. Snakes not infrequently die thus impaled by their food.

One of the most interesting passive defense reactions of lizards is that of

shedding the tail. An attacked lizard parts the tail on its own accord or with the aid of injuries to the member. As the tail severs from the body it bounds and bounces actively, attracting all the attention of the predator, who forgets momentarily at least about the owner, who slinks unobtrusively away and usually escapes. Some lizards do not part with the tail except as a last resort, while others, like the glass-snake lizard, will break the tail upon almost no provocation whatever. For an interesting account of the use of the tail as protection, see the quotations from Fitch in the discussion of *Gerrhonotus*.

Jopson (*lit. cit.*) suggests that the blue tail of the young of some skinks may be of definite survival value, and as the basis for the suggestion cites two instances in which a pair of dogs attacked a skink. In the one case the skink was young and still blue-tailed; it escaped upon parting with the tail as the dogs concentrated on the writhing member. In the other case the skink was a red-headed adult with a dun-colored tail; and although this animal too parted with its tail, the dogs did not lose sight of the animal itself, which was captured. In the same fashion the very conspicuous, light-colored tip on the tail of some geckos may serve to direct the attention of predators to a nonvital portion of the animal.

FOLKLORE

Lizards have been singularly free of the misconceptions that have popularly grown up about snakes. Perhaps the most common fallacious idea concerning them is that many are venomous. In many parts of the country various common or uncommon species are popularly considered as venomous and for that reason are feared by the people of that area. Actually, as stated before, the only venomous lizards in the world are the members of the genus *Heloderma*, of which only two species now exist.

According to the belief of many individuals, glass-snake lizards are endowed with the ability of breaking the body as well as the tail into many pieces. One variant of the tale has the lizard cautiously returning to put the parts back together as good as new. Of course all lizards, the glass snake included, break only the tail; they rarely show an interest in the pieces (infrequently a lizard will eat its own tail) and certainly never join the pieces together.

A number of years ago rumors about the horned lizard, particularly the Texan horned lizard, were legion, centering mainly about newspaper stories of these animals having been found ensconced in blocks of cement scores of years ago. The stories are, of course, without truth, for horned lizards like all other lizards need food, air, moisture, activity, and so on to maintain life over a very long period; horned lizards, moreover, have a maximum life span of some eight years. The stories probably stemmed from the discovery of a lizard in a cracked or otherwise imperfect block of cement.

In the western part of the United States some lizards are said to "boom" in a deep, penetrating tone, particularly at dawn and dusk. There is no truth in the statement. No lizard is known with a voice that can be heard more than about 50 feet. Geckos have the loudest voices of all lizards (see p. 64). Recently a popular writer attributed an extraordinarily powerful voice, equal to that of a small airplane engine, to a small African lizard. The attribution, like the American stories, was in error, even though the writer went to some length in attempting to prove his point.

In spite of the absolute impossibility of truth in the "hoopsnake" story (see Schmidt, 1925 and 1929, *lit. cit.*, for several versions), belief in its veracity persists tenaciously in many parts of the country, and at various times several different kinds of animals erroneously have been presented as proof of the existence of the mythical creature. Generally some kind of snake is chosen as "proof," but occasionally the legless lizard, *Ophisaurus*, appears. Of many elaborate misconceptions, that embodied in a recent newspaper article is one of the most striking. A picture shows an ordinary *Ophisaurus* hardened into a ringlike form from preservation in a cylindrical container; one hemipenis appears to be extruded, while a loose bit of flesh back of the head resembled a short foreleg. The tail has been broken, and a regenerating tip has grown to the length of an inch or so; this portion of the tail clearly has no poisonous properties, regardless of its odd, abnormal form. The tail would have continued to grow to its normal shape and length, under ordinary conditions, had the lizard lived. Yet this innocuous animal is construed, in the article mentioned, as proof of the existence of hoopsnakes; it is said to have struck a heifer three times on the nose, killing it; its regenerated tail is called a horn, and poison is said to be injected into a wound through a groove or opening in it!

In British Columbia a certain tribe of Indians, the Kwakiutl,

> believed that a person could be bewitched by placing a portion of the victim's clothing in the mouth of a lizard of which the head has been cut off, placing this in a snake's head and putting the whole inside the mouth of a frog (Boaz, 1896). Some members of the Salish tribe believe that the tail which has been dropped by a pursued lizard can be used to make a powerful love potion; 'medicine' containing dried lizard tails obtained in this way commands a high price among these people (Carl, *Can.*).

In tropical America fallacious tales of lizards are more abundant and picturesque, including the belief that one kind of lizard runs out and bites your shadow, whereupon the shadow thrower dies; that the mere sight of another species will cause a traveler to lose his way in the deep forests; and that still others emit a venomous vapor that kills all who breathe it. Fortunately these legends have not found their way into popular conception farther north.

ECONOMIC IMPORTANCE

Since most lizards are insect predators, they are of considerable value in the control of pests in various parts of the country. Knowlton (1932, *lit. cit.*) has proved their importance as predators of the beet leafhopper in Utah, and in Florida they are known to be of importance in the control of celery pests. In subtropical regions house geckos are valued as a means of control of mosquitos.

As food for man lizards hold but little value. Although all presumably are edible, only the chuckwallas and ctenosaurs, in the United States, are ever eaten. The flesh of the latter I know from personal experience is tender and savory.

Many other animals, however, prey freely upon lizards. Snakes and birds are of chief importance in this respect, and of not negligible importance are lizards themselves.

As a carrier of immature ticks (larvae and nymphs) some lizards may be of considerable importance. On the West Coast *Sceloporus occidentalis, Gerrhonotus coeruleus,* and *G. multicarinatus* are important hosts. In British Columbia "the Alligator lizard of the coast . . . is now recognized to be of considerable importance as a carrier of the Coast tick, which has recently attained prominence as a pest of man, pets and live stock. For that reason the abundance, distribution and life history of this reptile is of some interest to scientists who are studying tick parasites in this Province" (Carl, *Can.*).

Many parasites, internal and external, are harbored by lizards. Roundworms are the most common large internal parasite, and tapeworms are rarely found. Protozoons occur, and they have been studied by Wood (*Calif.*) for certain California lizards. Externally the most common parasites are mites, which frequently occur on the skin under scales, or in scaleless pockets as in the axilla, behind the insertion of the hind leg, or on the side of the neck. It appears in some cases that the pockets have developed especially for the benefit of the mites; other functions are difficult to imagine, yet as difficult to perceive is any advantage to the lizard in concentrating the mites in one particular spot, especially where they cannot be removed by scratching.

IN CAPTIVITY

Few lizards are popularly kept in captivity. Exceptions are the anoles and horned lizards. Others can be kept without great difficulty if some attempt is made to simulate natural conditions and properly provide water and more or less natural food. Directions for keeping anoles are given on page 98. Lizards do not make very satisfactory pets because they are not easily trained and are relatively very short-lived. Dr. Bishop, however, kept an anole as a house pet for nearly four years, at the end of which time the animal was killed accidentally.

The most satisfactory foods to raise for lizards in captivity are meal worms and cockroaches. According to *Wildlife Research and Management Leaflet* BS-92, published in May, 1937,

Directions in the bird books for raising mealworms are quite misleading; in order to work intelligently we must learn the life story from egg to egg. The first fact to learn is that the insect is single-brooded, that is, it requires an entire season to complete its growth. The beetles may be found laying eggs from May until freezing weather in the fall. The early eggs will produce larvae that are full grown by September or October of the same season; larvae from the late eggs do not attain their growth until about midsummer of the next season. A female beetle lays from 20 to 50 eggs. While practically any farinaceous material—cornmeal, ground feed, cracker crumbs, or bread crusts—is suitable for their propagation, feeding experiments have proved that wheat, in some form or other, is preferable and yields the best specimens. Fill a tight box or earthen jar half full of the food material, put in scraps of old leather, cover with woolen cloths, and fit with a lid of wire screen. Put in a few hundred larvae or beetles and leave undisturbed, except to insert a raw potato from time to time. If this is done about April, a good supply of larvae will be obtained for use the following fall, winter, or spring.

Methods of raising cockroaches are simple and may be carried on with little trouble. These well-known household pests are several-brooded and require a season to attain maturity. They are usually found around water pipes or insanitary sinks and drains, and under floors that are damp a good part of the time. The eggs are laid in a bean-shaped pod, which for some time during formation remains attached to the body of the female. When starting a colony, select females bearing egg cases. Place a number in a glass or earthen jar that has half an inch or so of moistened paper in the bottom and cover to prevent their escape. Put some bread soaked in sweetened water in the jar occasionally, as feeding experiments have shown that this is preferable and inexpensive. Animal or vegetable grease in nearly any form and fruit also are eaten. Under favorable conditions there will be a good supply of young cockroaches within a month.

COLLECTING

Lizards may be collected by hand, noosed, trapped, or shot. Collecting by hand is successful only for those that may be closely approached; this is not true of most desert species. Some species are regularly found under rocks or in rock crevices, in trees and bushes, or in and under logs. These can, with patience and quick movement, be caught by hand. Occasionally fast-moving species, like *Holbrookia texana* and some cnemidophori, are found on cloudy days under movable objects where they can be caught by hand if the hand moves quickly and does not hesitate. Otherwise such species can be caught by hand only by running them down, a procedure not suitable for the usual collector. Sometimes they can be chased into mammal holes from which they can be dug. In many areas of the country pack rat nests are good places to look for various lizards, although the amount of work necessary to dig them

out thoroughly is considerable. Some collectors, working in pairs in areas where lizards can be expected under many stones and where the ground is fairly level, obtain good results by having one turn the stone and the other quickly grab or cover the exposed surface of the ground with an insect net. Irregular surfaces prevent this method from being widely useful. When the hands must be used, frequently it is necessary to start grabbing as the stone is being lifted; gloves are a valuable adjunct in such collecting.

Lizards that cannot be approached closely enough to be grabbed by hand can sometimes be caught with the aid of a thread two or three feet long, with a noose at the end, dangling from a three- or four-foot stick. So approached, the lizard focuses its attention on the human intruder and seldom suspects the noose, which it often tosses aside with a quick motion of the head, as if in mere annoyance. They also can be stunned by a blow with a slender twig. Slingshots are effective in trained hands and can be used with small stones or even packets of fine lead shot. Lizards that can be approached sufficiently closely can sometimes be stunned momentarily if hit with a handful of dirt; this is sometimes effective in the collecting of geckos.

Night hunting is not very effective since most lizards are diurnal. However, geckos are nocturnal and sometimes best hunted at night; not infrequently one can catch a few diurnal lizards at night as they sleep or as they are rousted from their hiding places. Ground geckos can be found by walking about, with gasoline lanterns held in front of the body, in areas where they are known to occur such as near the bases of hills and along the banks of arroyos.

Trapping is a method of capture not frequently used but effective under some circumstances. Rodgers (*lit. cit.*) describes a trap suitable for terrestrial species, where they are abundant. Vogt (*lit. cit.*) suggests another style, to which lizards are attracted by shade. Babcock (*lit. cit.*) describes still another, effective in the capture of at least the Bermudian skink (*Eumeces longirostris*):

> A large glass jar is sunk to its brim in the ground near rocky areas frequented by this shy and quick-motioned reptile. The inner surface of the jar is smeared with butter, and the collector then withdraws. Within an hour a goodly supply of specimens are found in the jar, having fallen in while reaching down to get the butter and being unable to escape from their slippery prison.

Shooting with .22-caliber dust-shot shells is a common practice for lizards that cannot be approached closely. These are effective only in guns with worn riflings or, preferably, with smooth bores. Larger species, like *Dipsosaurus* or *Sauromalus*, can be killed only at close range with these shells, so that a larger caliber may be desirable, as for instance 9-mm. shells. Ctenosaurs can be killed with still larger shells, as .410 shotgun shells, or .22-caliber bullets.

PRESERVING

Lizards can be killed in various ways. Drowning in water is satisfactory if sufficient time is available. Hot water will kill in a few moments. A very practical method is drowning in alcohol. Ether or chloroform can be used, but they are not easy to keep in the field. When none of these means are practical, lizards can be killed by striking the heads on rocks or other solid objects. Of course the skull of animals killed in such fashion is not satisfactory for osteological study. A sharp, slender probe inserted in the mouth and forced through the roof of the oral cavity into the brain will accomplish the same thing, but it is less humane.

Once killed, the specimen should be numbered with a tag, and the locality and date of collection, the collector's name, and other notes should be entered opposite that number in a catalog, or else a tag bearing all such data can be tied to each specimen. Ordinary paper will not suffice for this, since it becomes soft and may disintegrate. Waterproof paper such as that sold by the Dennison Manufacturing Company of Chicago is very satisfactory. If available, thin strips of tin may be used and the data scratched deeply into them with a nail point or other hard, pointed object. A longitudinal slit should be made along the ventral surface of the belly, and other short slits on the ventral surface of the tail. Slits in the legs are desirable also in large species. All slits, particularly that in the belly, should be deep and open. Large lizards, such as chuckwallas or ctenosaurs, should have the abdominal organs removed, else the preserving fluid will not penetrate properly throughout the tissues. The lizards can then be placed in shallow pans of 10 per cent formalin (4 per cent formaldehyde). They should be completely covered with the fluid and so arranged that the body parts are in a more or less normal position. The specimens should be left in this solution until thoroughly hardened, and then transferred directly to 75 per cent alcohol, in which they should be kept permanently. When transferring the specimens from formalin to alcohol and when removing them from alcohol for study, never place them in water, for this immediately diffuses under the scales, loosening them so that they pop off like chaff from wheat. This is undesirable as most of the color and pattern are lost when the scales are removed, unless the specimen had been about ready to shed anyway when killed. No specimens should ever be left in formalin longer than necessary, for after a short time this fluid discolors them. In fact, certain lizards, particularly skinks, are best preserved directly in full strength alcohol. Specimens so preserved, however, must be watched carefully to be sure that they are hardening properly and that the alcohol does not become too dilute through diffusion into it of the body fluids. Thus when using alcohol to preserve specimens directly, give each specimen about ten times its own bulk in alcohol to cover it. Whether formalin or alcohol is used for the initial hardening, piling of specimens on top of each other should be avoided;

this is very important if alcohol is used. When the specimens are stored in 75 per cent alcohol later, they should be sufficiently hardened to permit the placing of many of them in the same container. They should always be covered with fluid.

Further information on the collection and preservation of reptiles may be found in articles by Slevin, Klauber (1935), and Gloyd (all *lit. cit.*).

AMERICAN SAUROLOGISTS

In the old days, even as at the present time, no specialists in lizard study existed. The founders of herpetology in this country were equally important as students of snakes and amphibians. The reader is referred to Schmidt and Davis' *Field Book of Snakes*[6] for a brief account of these early herpetologists and the development of herpetology in this country.

Of more modern herpetologists John Van Denburgh probably wielded a greater influence than any other student of lizards in North America, since he was concerned mainly with the West, where most of our lizards occur. His work through a quarter of a century embraced three quarters of the species of lizards known today in the United States. A series of scholarly monographs culminated in 1922 with his most important work, *The Reptiles of Western North America,* which ranks as one of the greatest classics of all time in North American herpetological literature. Its remarkable usefulness will undoubtedly be maintained for many years to come.

One cannot, however, mention Van Denburgh without referring also to his student, Joseph R. Slevin, who holds the position at the California Academy of Sciences that was left vacant by the death of Van Denburgh. An indefatigable collector, Slevin is almost exclusively responsible for the large and superbly preserved herpetological collections of the California Academy. Probably no other collector has contributed equally valuable material, at least from North America, and it is a recognized fact that Van Denburgh's researches profited greatly from Slevin's efficiency in the field.

To the late Raymond L. Ditmars of the New York Zoological Society herpetologists owe a great debt of gratitude for his influence in popularizing the study of reptiles and gaining for it the interest, or at least the attention and support, of untold thousands of readers and listeners who may have read some of his many popular articles and books (among them are *The Reptile Book* of 1907 and *The Reptiles of North America* of 1936) or have heard his spellbinding lectures.

The name of Miss Mary C. Dickerson is an important one in North American saurology. In the early part of the twentieth century she was curator of herpetology at the American Museum of Natural History, and late in her stay there she described a very considerable number of lizards from Baja California, fifteen of which are currently recognized. More important by far than

[6] New York, Putnam's, 1941, pp. i–xiv, 1–322, pls. 1–34, frontis., figs. 1–103.

Pl. 2. Some authorities influential in the development of American saurology. *Top row:* Mary C. Dickerson, 1866–1923; John Van Denburgh (about 1921), 1872–1924. *Middle row:* Charles W. Gilmore (about 1933), 1874–1945; Raymond L. Ditmars, 1876–1942. *Bottom row:* Laurence M. Klauber, 1883–; Joseph R. Slevin (about 1921), 1881–.

this series of new species introduced by her, however, was her influence upon a number of young students who subsequently became great in herpetology; among the more outstanding are Noble, Schmidt, Camp, and Dunn, all of whom early in life were encouraged in their herpetological endeavors by her guidance and generosity. The first three have been particularly important in the study of North American lizards.

As an experimental biologist, concerned with the field of herpetology, the late G. Kingsley Noble of the American Museum of Natural History contributed a remarkable amount of fundamental work on the life history and "naturalist's physiology" of lizards; his many novel studies have been, and it is hoped will continue to be, a very important stimulus for further undertakings of a similar nature.

Charles Lewis Camp, now of the University of California, will long be remembered for his erudite and invaluable *Classification of the Lizards,* a work of unparalleled vision and scope in lizard anatomy and taxonomy. This work was produced under William K. Gregory's tutelage at Columbia University. In California Camp has dealt also with the taxonomy of several western species of lizards.

Without peer in the study of saurian paleontology and osteology is the late Charles W. Gilmore of the United States National Museum, whose monumental *Fossil Lizards of North America,* a model of thoroughness, has been followed by numerous supplementary studies on the same topic.

Perhaps no student of recent American lizards has contributed more taxonomically than Karl P. Schmidt of the Chicago Natural History Museum, whose summaries of many lizard genera in his herpetology of Baja California, and separate studies of *Holbrookia,* the utas, and various other southwestern genera have been and still are indispensable.

In addition to brief studies on both recent and fossil lizards, Edward H. Taylor of the University of Kansas has contributed a taxonomic study of *Eumeces* which is undoubtedly the peer of all generic monographs of lizards in North America. The work is the product of a phenomenal sense of taxonomic discernment which is probably unparalleled among American herpetologists.

Another western herpetologist, L. M. Klauber of the San Diego Zoological Society, of greater fame as an ophiologist, has observed and recorded many interesting and valuable facts concerning especially the natural history, but also the taxonomy, of western lizards.

Outstandingly a student of lizards, of America and elsewhere, is Charles E. Burt of Quivira Specialties Company, Topeka, Kansas, whose many summaries include an important and recent key to United States lizards and a monograph on the extremely difficult genus *Cnemidophorus.*

Excellent, ideally detailed, and meticulously executed studies of smaller, intrageneric groups—i.e., of *Gerrhonotus, Cnemidophorus, Sceloporus,* and

Pl. 3. Some authorities influential in the development of American saurology. *Top row:* Edward H. Taylor (1944), 1889–; Karl P. Schmidt, 1890–. *Middle row:* Charles L. Camp (1935), 1893–; Charles E. Burt, 1904–. *Bottom row:* Henry S. Fitch, 1909–; Joseph A. Tihen, 1918–.

Eumeces—which are unexcelled in the application of field observations and geographic implications to taxonomic problems, have appeared or are in preparation by Henry S. Fitch, and his colleague Thomas Rodgers, of the University of California.

The summary of the genus *Gerrhonotus* which has been prepared by Joseph Tihen of the University of Rochester and which is still in manuscript is one of the most carefully considered systematic studies of a large lizard group of this continent.

The difficult "supergenus" *Uta* (*sensu lato*) has been broken down into more nearly natural groups by Myron B. Mittleman, who summarized one group (*Urosaurus*). Other, perhaps lesser but nonetheless important, works of other students have contributed notably to our present knowledge of American lizards. Many of the more important will be found listed in the bibliography.

PROBLEMS

No field in United States herpetology is more in need of investigation and offers more attractive problems than that of the lizards. The general pattern of study to be recommended for students with a beginning interest in lizards does not differ from that so admirably presented for the study of snakes in Schmidt and Davis' *Field Book of Snakes* (pp. 68–77). The specific problems posed by lizards are many. It may truthfully be said that in general the lizards of this country are less well known than the snakes or, in fact, any other group of reptiles and amphibians. Although most of the distinct species are probably known, the geographic races are not well defined. Many widespread species contain races not yet recognized, and some acknowledged races are scarcely recognizable even by specialists. This rather poorly advanced state is largely due to the multiplicity of characters and their bewildering variability in lizards in general. As a rule forms with the most complex scutellation are the least well known. Until recently investigators have generally taken almost limitless variation for granted, and have resorted to general terms to define their groups. Recent work by Rodgers, Fitch, Oliver, Taylor, Klauber, and others shows that even in the most variable genera characters exist, if sought for, that can be used in a concrete fashion to define races and species. In spite of the inroads effected by these specialists upon the systematic problems offered by lizards of this country, many very attractive questions remain to be settled. Chief among them is the *Phrynosoma douglassii* complex. Many questions are posed by *Cnemidophorus* and the several genera of utas. Other problems concern mainly single species; many could be listed.

The habits and life histories of but few species are known. As usual, and as they should, such studies lag far behind systematic studies. Imagine what a loss had someone in Alabama, for instance, ten years ago studied in great detail the life history of the five-lined skink in that region, not realizing that

three instead of one species were involved! As it is, many isolated natural history notes of the past on *Eumeces fasciatus* are lost for lack of certainty to which species they apply. Such a case probably will not be repeated in the history of United States saurology, but it well illustrates the point that fairly complete systematic knowledge should precede life history studies. Students of life histories should watch for systematic implications in their studies; they teem in the natural history of any species, yet are seldom appreciated.

For many species, the best-known feature of their natural history is their food habits. This phase has been subjected to greater study for Utah species than for others, thanks perhaps originally to the investigations of Herbert J. Pack, whose studies have been carried on chiefly by Dr. George F. Knowlton.

PART II

ACCOUNTS OF SPECIES

KEY TO FAMILIES

1\. Neither forelegs nor hind legs evident externally 2
Either forelegs or hind legs evident, or both 4

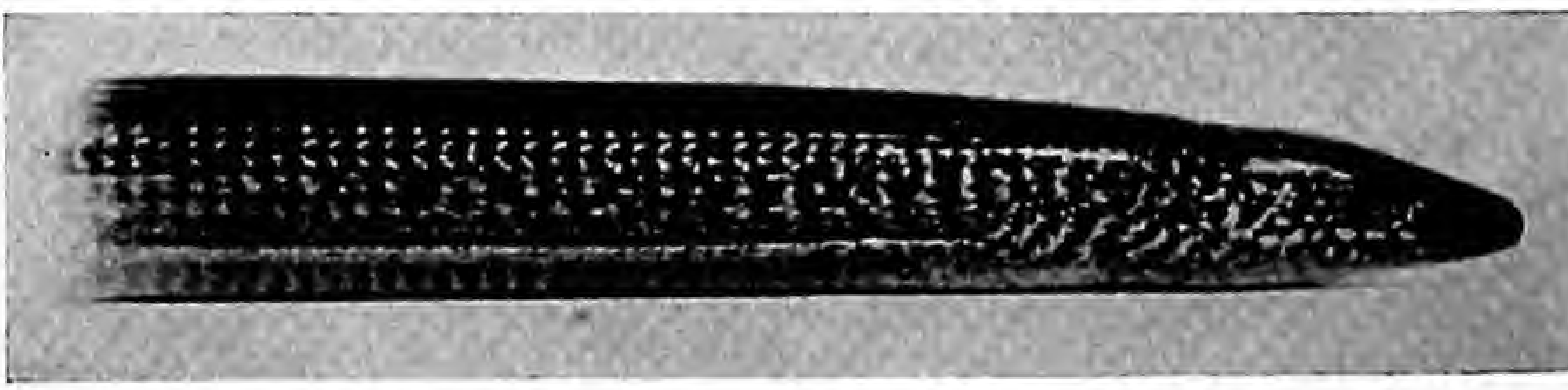
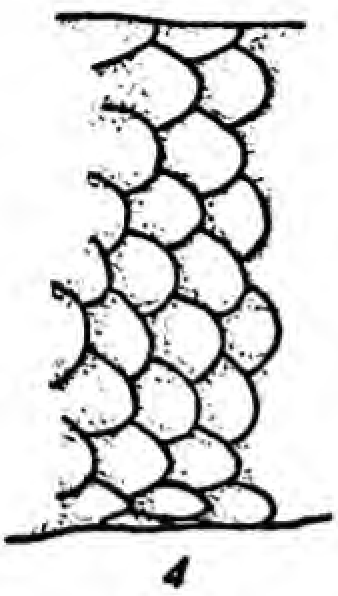


FIG. 2. *Ophisaurus ventralis*, side of head and fore part of body.

2\. Ear opening present; a very well-defined fold along each side (Fig. 2) . . . . ANGUIDAE (p. 437)
No ear opening; no lateral fold 3

FIG. 3. *Rhineura floridana*, side view of head and of section of body. From Cope.

3\. Eye opening absent and eye not discernible; body encircled by numerous earthwormlike rings (Fig. 3) . . . . AMPHISBAENIDAE (p. 431)
Eye opening present (Fig. 5); body covered by smooth, cycloid scales (Fig. 4) not arranged in annuli as described . . . . . . ANNIELLIDAE (p. 476)
4\. Only forelegs present, diminutive (Fig. 6) . . . . . . AMPHISBAENIDAE (p. 431)
All four legs present, although perhaps very small 5
5\. No eyelids; eye permanently open (Fig. 7) 6
Eyelids present, movable 7



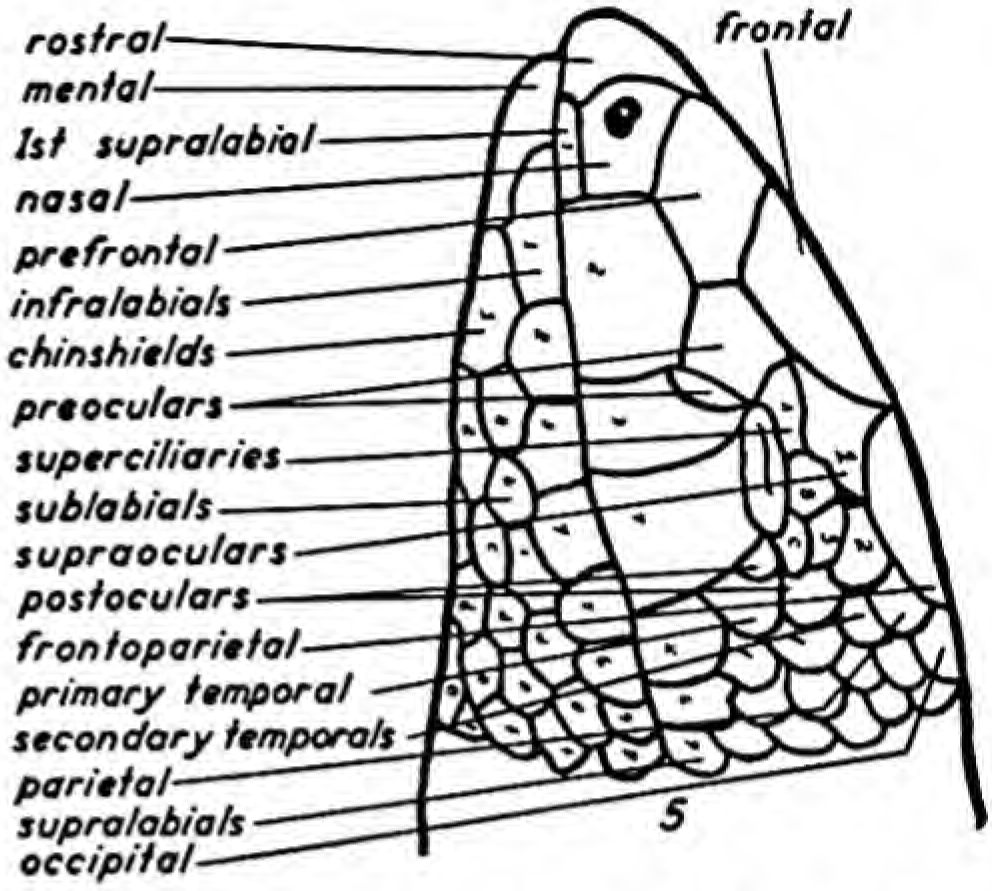
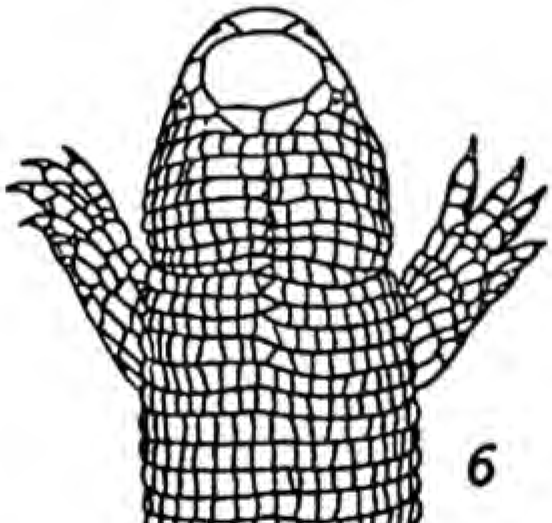


FIG. 4. Section of body in side view, in *Anniella pulchra*. From Burt, after Cope.

FIG. 5. *Anniella pulchra*, side of head. From Cope.

6. Head covered with very large, flat plates (Fig. 8); ventral plates quadrangular (Fig. 9) .... XANTUSIIDAE (p. 321)
   Head covered with granular scales (Fig. 10); ventral plates rounded (much as in Fig. 12) .... GEKKONIDAE (p. 64)



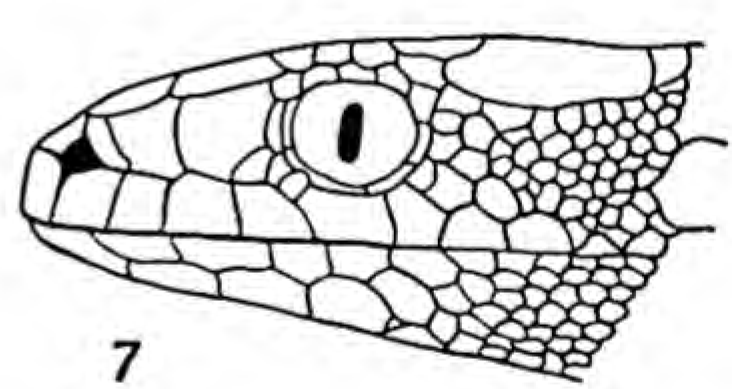
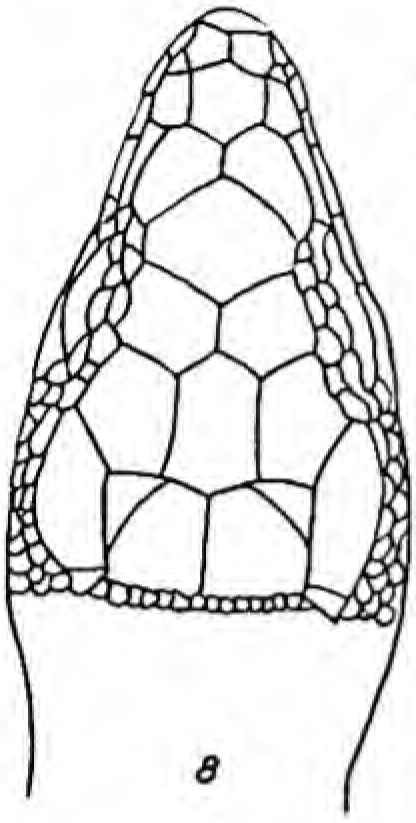
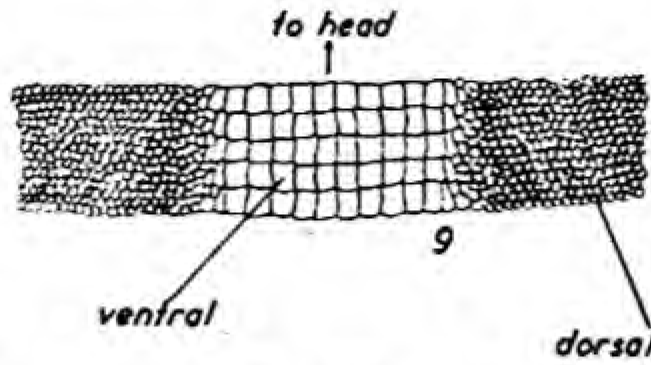
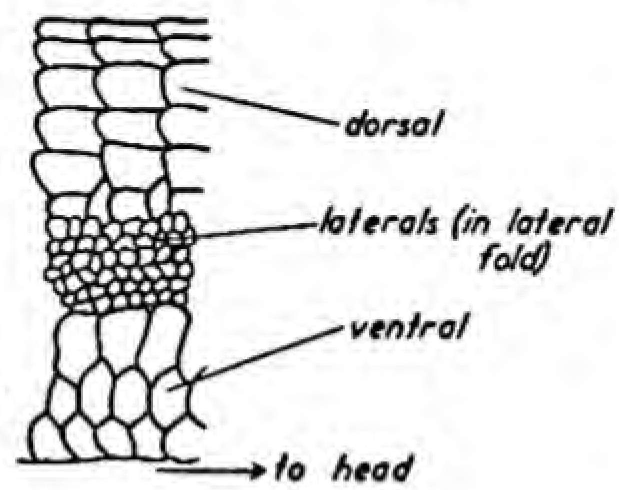


FIG. 6. *Bipes canaliculatus*, top of head and shoulder region. From Bocourt.
FIG. 7. *Xantusia riversiana*, side of head. From Cope.

7. A granular fold along sides of body; dorsal *and* ventral scales large, overlapping (Fig. 11) .... ANGUIDAE (p. 437)
   No granular fold along sides of body, bordered above and below by large dorsal and ventral scales 8
8. All scales on body perfectly smooth, flat, rounded, overlapping, more or less equal in size (Fig. 12) .... SCINCIDAE (p. 334)
   Not as described; dorsal scales much smaller than ventral scales, or granular, keeled, or pointed 9







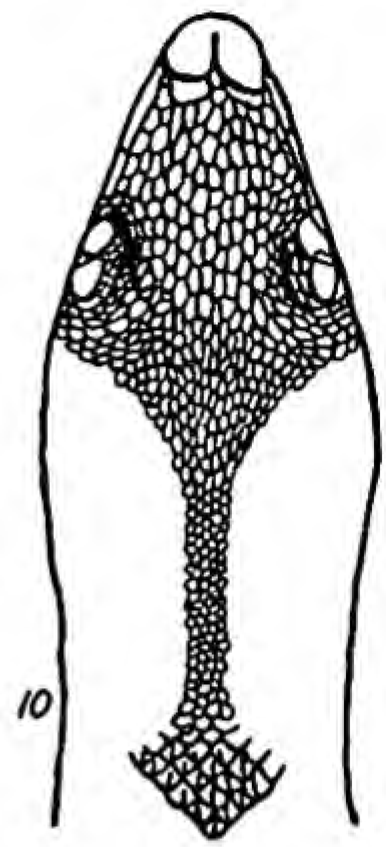


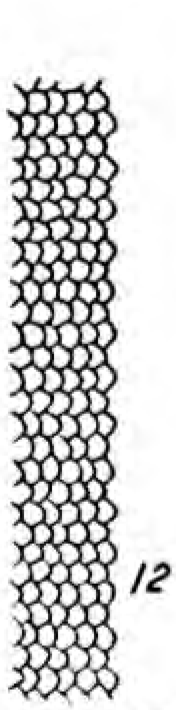
FIG. 8. *Xantusia riversiana,* top of head. From Cope.

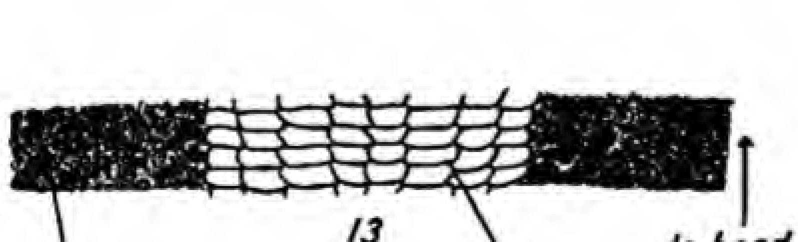
FIG. 9. *Xantusia vigilis,* strip of scales around middle of body, broken at mid-dorsal line. From Burt.

FIG. 10. *Sphaerodactylus notatus,* top of head. From Cope.

FIG. 11. *Gerrhonotus liocephalus infernalis,* section of body in side view. From Cope.

9. Belly scales very large, quadrangular, in only 6 or 8 longitudinal series (Fig. 13) 10
   Belly scales smaller, in several rows or not obviously in longitudinal series 11





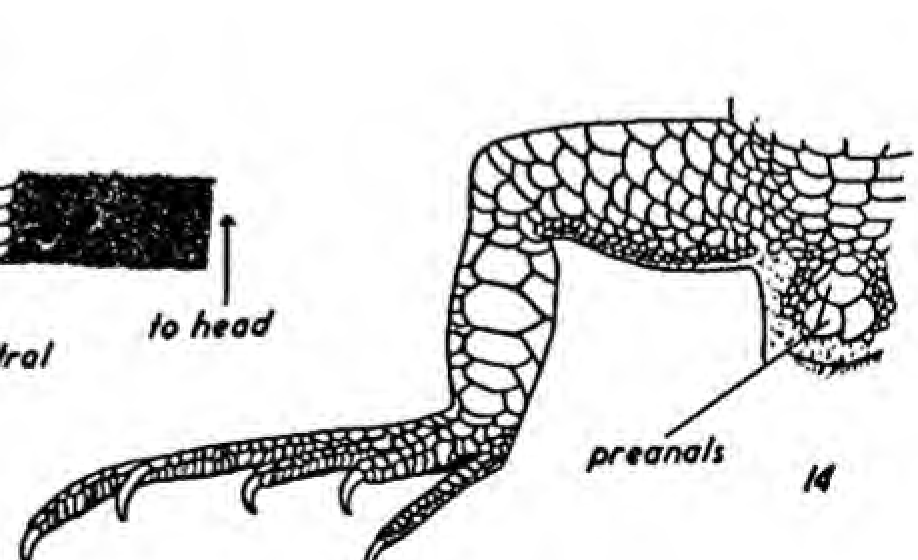


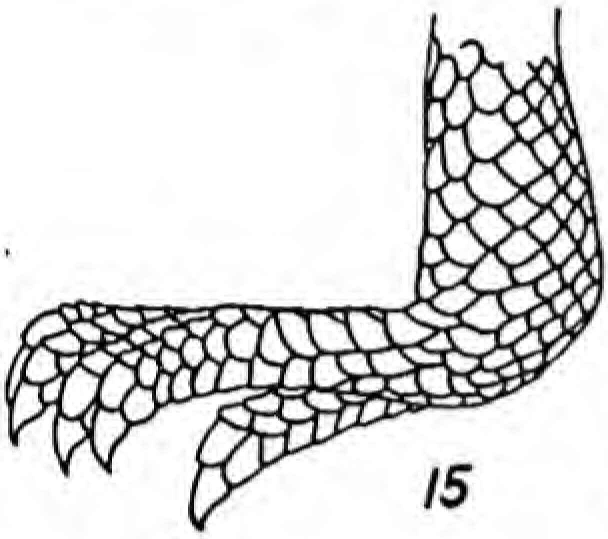
FIG. 12. *Eumeces tetragrammus,* strip of scales around middle of body, broken at middorsal line. From Burt.

FIG. 13. *Cnemidophorus sexlineatus,* strip of scales around middle of body, broken at middorsal line. From Burt.

FIG. 14. *Cnemidophorus t. tesselatus,* ventral view of right hind leg and anal region. From Cope.

10. Belly scales in 6 longitudinal series; a single large preanal scute .... LACERTIDAE (p. 398)

Belly scales in 8 longitudinal series; several enlarged preanal scutes (Fig. 14) .... TEIIDAE (p. 402)



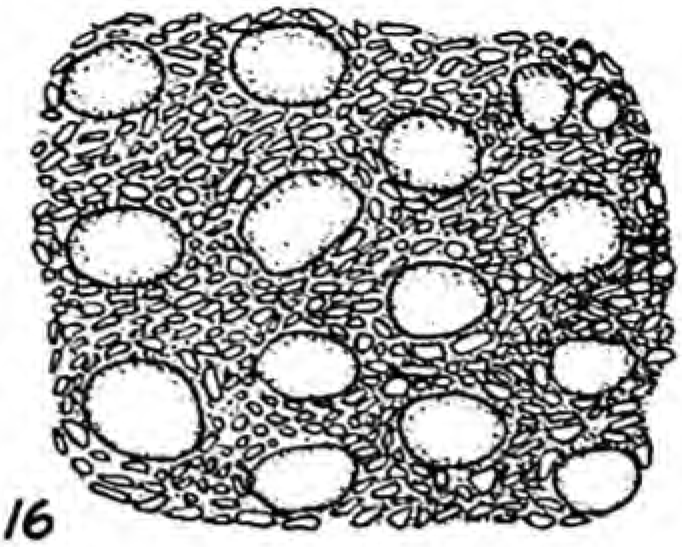
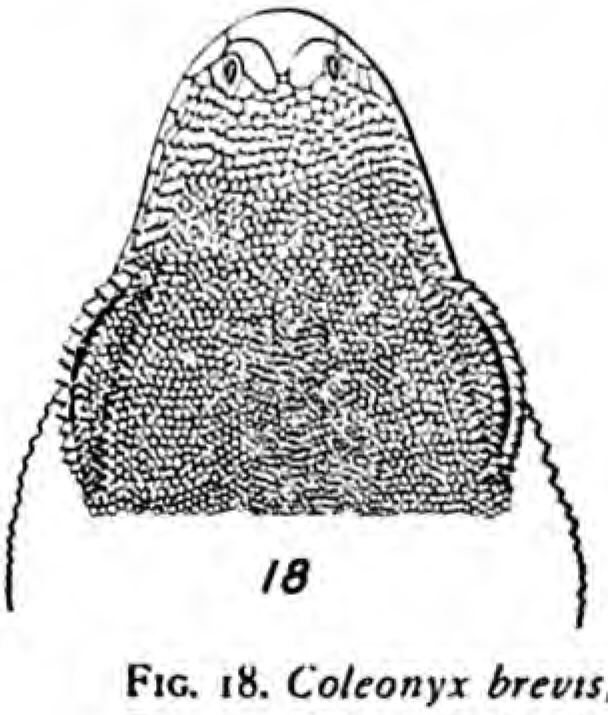
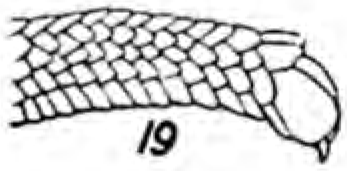


FIG. 15. *Heloderma suspectum*, ventral view of right hind foot. From Cope.
FIG. 16. *Heloderma suspectum*, patch of dorsal scales. From Burt.
FIG. 17. *Coleonyx brevis*, ventral view of right hind foot. From Cope.

11. Digits on hind leg of nearly equal length (Fig. 15); belly scales quadrangular; dorsal surface covered with large, beadlike granules, all separated from each other (Fig. 16) .... HELODERMIDAE (p. 471)

Digits on hind leg varying greatly in length, fourth toe nearly or fully twice as long as fifth (Fig. 17); belly scales pointed or rounded, but not quadrangular; dorsal surface not as described 12





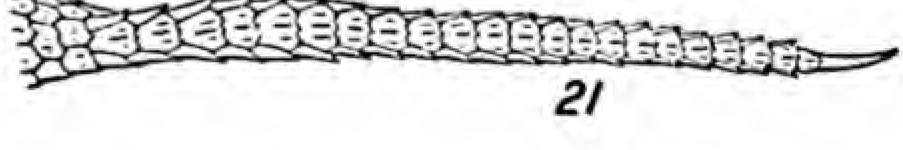


FIG. 18. *Coleonyx brevis*, top of head. From Burt.
FIG. 19. *Coleonyx brevis*, side view of fourth toe. From Burt.
FIG. 20. *Phrynosoma coronatum frontale*, top of head. From Burt.
FIG. 21. *Sceloporus woodi*, ventral view of fourth toe. From Burt.

12. Head and most of body, except belly, covered with very minute granules (Fig. 18); no parietal "eye"; no keels along ventral surfaces of digits (Fig. 19) .... GEKKONIDAE (p. 64)

Head covered with larger plates; a parietal "eye" usually visible (Fig. 20); 3 to 5 keels along ventral surfaces of digits (Fig. 21) IGUANIDAE (p. 87)

The Geckos

Family GEKKONIDAE

This is one of the most distinct of the groups of lizards. Practically all its members are nocturnal in habit, have vertical pupils, and lack eyelids. Large eyes and expanded tips on the digits are very characteristic of the group. The tail is very delicate, easily broken, and readily regenerated. Almost all species are capable of climbing with relatively great freedom on vertical walls and even on rough ceilings by virtue of the adhesive pads on the feet. They crawl about almost with the freedom of flies. In the tropics geckos are among the most common of lizards, especially in coastal or lowland towns where they are frequently found about houses. Away from the tropics, however, these interesting lizards are of less common occurrence; they enter the United States only in the extreme South. Most if not all species are capable of uttering a single, squeaky note; they are frequently heard chirping at night in the tropics. The only United States species which may do so frequently is, I believe, the warty gecko. I have not heard it, nor seen records that it squeaks, but its very close relative, the Philippine house gecko (*Hemidactylus frenatus*) chirps very freely. It has been suggested on the basis of some few observations that the chirps are mating calls.

A peculiar structure occurring only in geckos, but not in all species, is a very small sac under the skin on either side of the base of the tail on the ventral surface. The sacs are shallow and do not appear modified on the interior. They open to the exterior in a pair of semicircular slits just behind the anal opening. Their function is no doubt correlated with the presence of 1 or 2 small cloacal bones, imbedded in tissues near each sac. Presumably the entire structure serves as an organ of stimulus during the mating activities.

Three subfamilies are known. One, Uroplatinae, is restricted to Madagascar. All species are egg-laying.

Members of this family in the United States can be recognized by the large, lidless eyes or, if the eyes have lids, by the very small, flat, smooth scales on the body and head, the vertical pupil, and the translucent, almost transparent skin. The following key will separate United States genera of the family.

KEY TO GENERA OF GEKKONIDAE

1. Eyelids present; digits not expanded (Fig. 19) .... *Coleonyx* (p. 78)
   Eyelids absent; digits expanded or not 2

2. Digits not expanded (Fig. 22) .... *Gonatodes* (p. 65)
Digits expanded, at least at tips (Figs. 23–25) 3
3. A single round pad at tips of toes (Fig. 23); size rather small; head pointed; scales uniform on back .... *Sphaerodactylus* (p. 72)
Not so 4

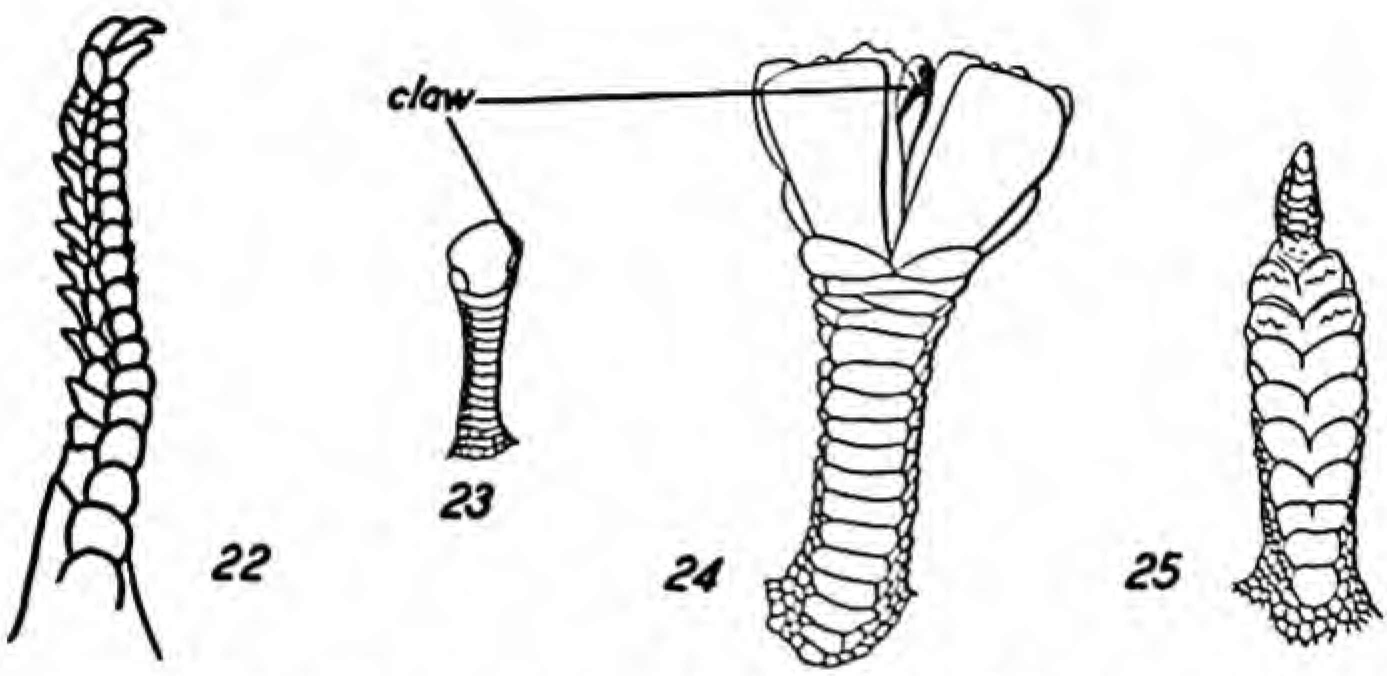


FIG. 22. *Gonatodes fuscus*, ventro-lateral view of fourth toe. From Bocourt.

FIG. 23. *Sphaerodactylus cinereus*, ventral view of fourth toe. From Burt.

FIG. 24. *Phyllodactylus tuberculosus*, ventral view of fourth toe. From Burt.

FIG. 25. *Hemidactylus t. turcicus*, ventral view of fourth toe. From Burt.

4. A double pad at tips of toes, the claw between the two pads (Fig. 24) .... *Phyllodactylus* (p. 68)
Most of the lamellae under digits expanded, except for the last, claw-like joint which projects from near the end of the digit (Fig. 25) .... *Hemidactylus* (p. 70)

The True Gecko Section: SUBFAMILY GEKKONINAE

The true geckos comprise the bulk of the family; in fact only seven genera of the family are excluded from this subfamily. The amount of variation in external appearance in the very numerous genera and species of the subfamily is very great. The subfamily is based upon internal characters, which show a lack of the specialization apparent in the other two subfamilies.

The Padless Geckos

Genus *GONATODES* Fitzinger

Numerous species of this genus are known to science. Only one has been found within the borders of the United States, in the Florida keys. Most dis-

tinctive of the characters of the genus are the lack of dilation of the digits (see Fig. 22), the presence of rudimentary eyelids at the edges of the orbit, and the absence of preanal or femoral pores. Thus the genus probably is one of the more primitive of the family. All the species are rather small. Some are said to be more completely diurnal than any other gecko. The pupil is usually recorded as round; but Grant (*Fla.*) states that it is found in this condition only when the specimen is killed at night or in darkness, whereas if it is killed during the day in light the pupil is vertical.

Yellow-headed Gecko *Gonatodes fuscus* (Hallowell)

(Fig. 22, p. 65; Pl. 4)

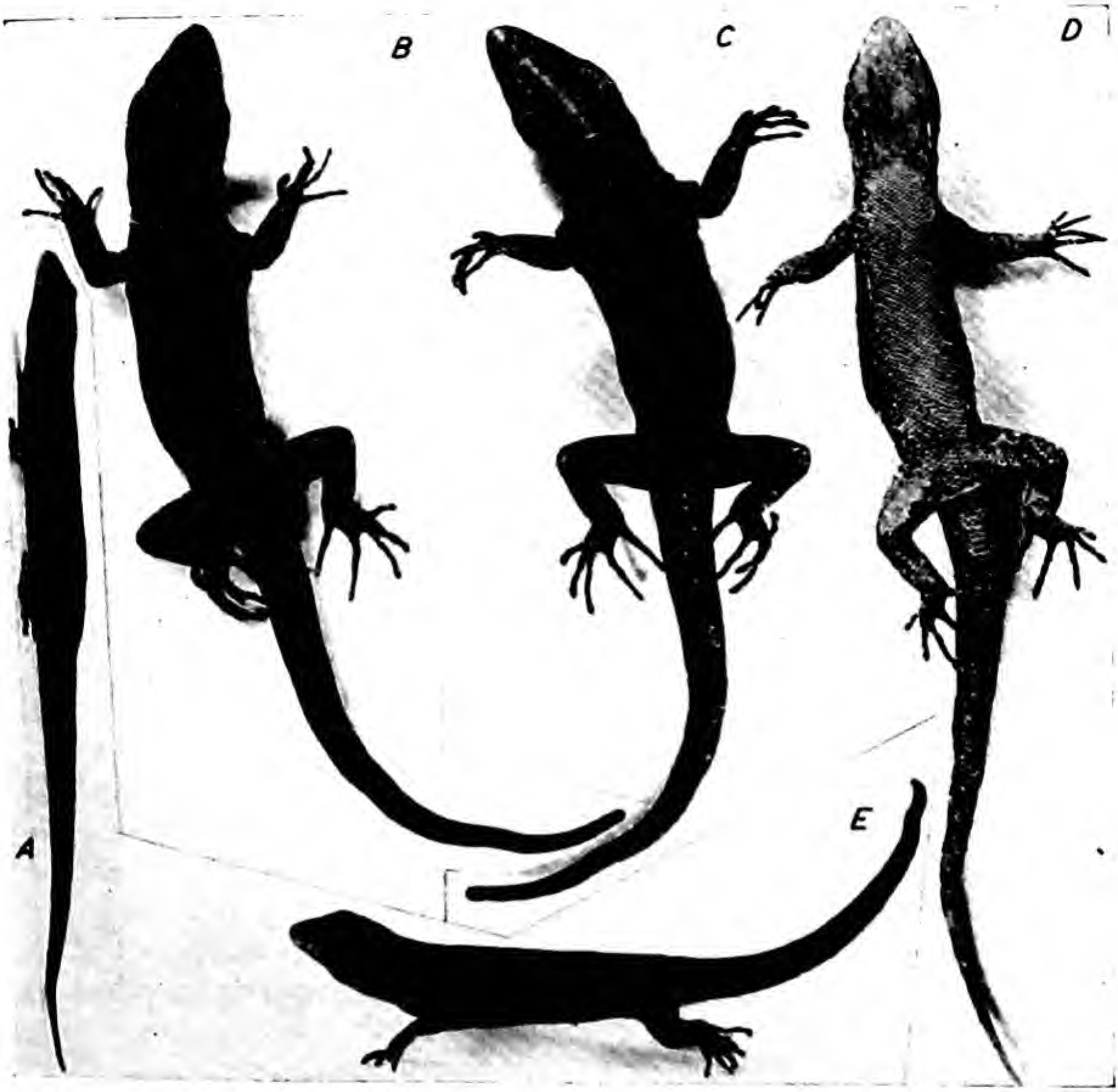
Range. Jamaica, Cuba, and Nicaragua south to Colombia; Key West. An introduced species in Florida and probably in Cuba and Jamaica. Type locality—Nicaragua. (Map 38, p. 511.)

Size. The maximum snout-vent measurement is about 38 mm. (1½ in.). The tail is only a little greater in length than the head-body measurement if the complete, original one is present. Newly-hatched young measure about 15 mm. (9/16 in.) snout to vent. The head and body are slightly depressed and the limbs well developed; the hind legs are noticeably stouter than the forelegs.

Color. Very variable. The head and neck are yellowish or orange in males. The dorsal ground color usually is gray-brown. It may be perfectly uniform over the entire animal dorsally; it may be varied with darker and lighter spots more or less regularly arranged; or it may be supplanted by a very dark coloration posterior to the shoulders. The markings, when evident, may include a white vertical line in front of the forelegs, bordered on either side by black; in the black areas small white spots may be present. These markings may accompany other conspicuous dorsal marks or they may not. On each side of the body, posterior to the shoulders, is a series of 4 to 6 black or dark brown, rounded spots each frequently bordered posteriorly by a narrow white line; these markings may be extended medially, giving rise to a faint cross-banded effect. The spots may be present on the basal portion of the tail, but otherwise the tail is a uniform gray-brown. The limbs may be unicolor or with numerous small, rounded, light spots. The belly is usually light.

In certain very dark specimens the dorsal surfaces posterior to the shoulders, the belly, the lower surfaces of the hind legs, and the subcaudal surfaces become suffused with black; only the head remains relatively light. The sides of the gular region may also be overspread with black; in such specimens a narrow, median, white line is usually present and frequently a few narrow, diagonal lines on either side.

The tip of the tail, unless regenerated, is almost white, contrasting conspicuously with the color of the rest of the tail.



Pl. 4. *Gonatodes fuscus.* Key West, Florida. A, D, female; B, C, E, male. Courtesy of Arthur Smith and Robert McCauley.

Scalation. The head, body, and limbs are covered above with small, convex tubercles that may project outward from the body a distance equal to their length. Eye very large, separated from the labial border by ½ to ⅔ of its diameter; sometimes a small black spine in skin bordering the eye above. Rostral large, grooved above; supralabials decreasing in size posteriorly, 6 to below middle of eye; a large mental; ear opening small. Belly scales and scales on tail flat, overlapping, larger than dorsal scales. Dorsal scales on tail rather irregular, especially toward tip; a row of median subcaudals enlarged. Lamellae on base of digits slightly enlarged (Fig. 22). No femoral or preanal pores.

Recognition Characters. The yellow head and neck, the small size, the large eyes lacking lids, and the absence of expanded pads on the digits identify this species.

Habitat. Found about dwellings or other buildings, inside or out.

Habits. Grant says that in Jamaica "they are easily taken by hand, but the old males are somewhat shy. The eggs are large in comparison with the animal, measuring 8 x 6.5 mm. They are white, brittle and at no time adhesive, although probably soft-shelled when laid. Ten eggs were found in one crevice in a house where most of the specimens were taken." They are said to be diurnal.

Problems. The taxonomy of this species and its close relatives needs some investigation. According to Grant there are some curious discrepancies in color descriptions that need explanation. The details of the life history remain to be investigated.

References. Grant, 1940, pp. 65–67, description and habits (*Fla.*).

The Artiodactyl Geckos

Genus *PHYLLODACTYLUS* Gray

This is a large genus of numerous species. The species are of rather large size, and the single one that occurs in the United States is the largest gecko of the country. The chief characteristic of the genus is the pair of pads at the tip of each digit, between which the claw is placed (Fig. 24); the paired pads are somewhat reminiscent of the divided hoof of pigs and their relatives (Artiodactyla). Details of the scutellation of a typical species are shown in Fig. 26.

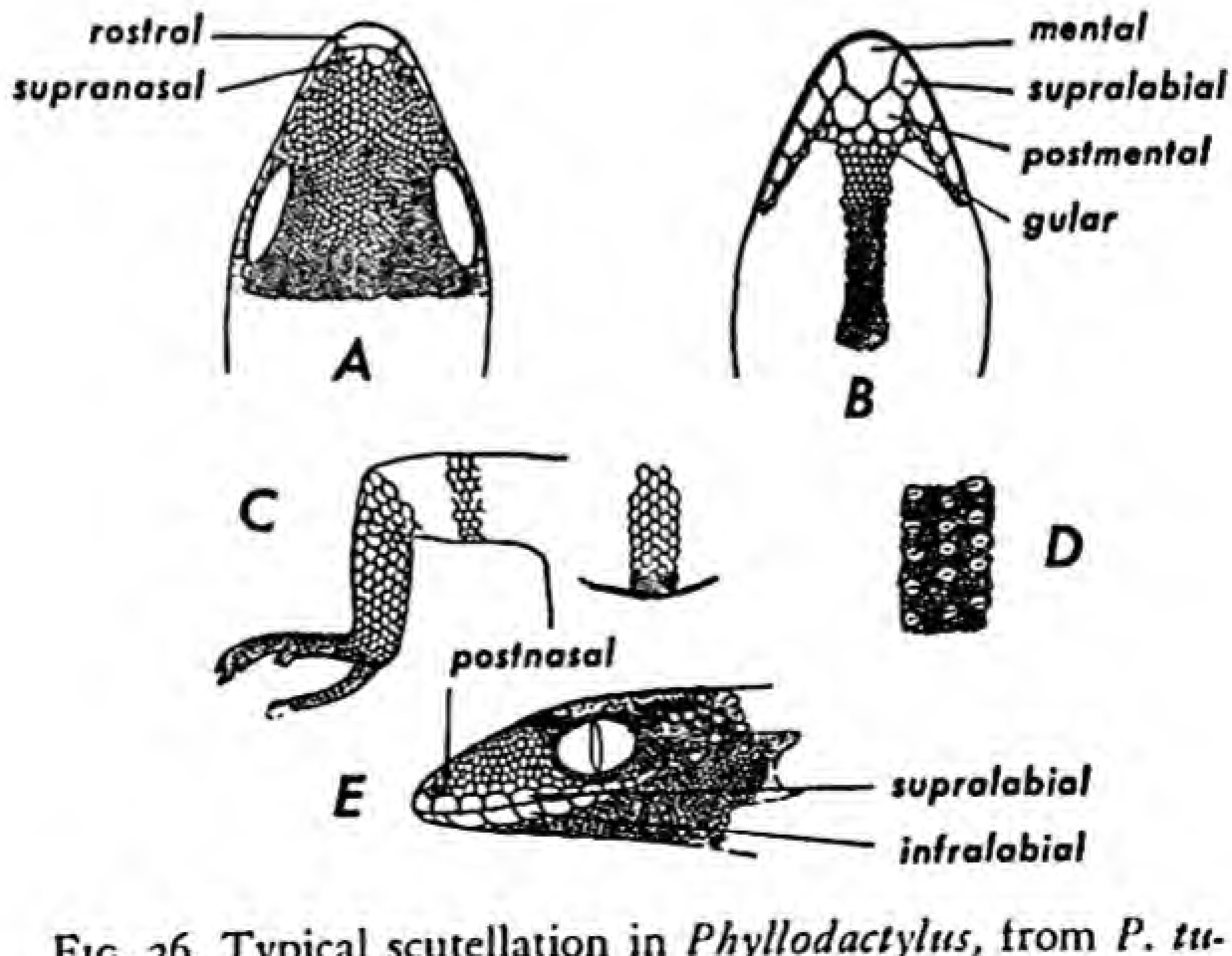


Fig. 26. Typical scutellation in *Phyllodactylus*, from *P. tuberculosus*, La Paz, Baja California. A, top of head; B, underside of head; C, underside of right hind foot; D, patch of dorsal scales; E, side of head. From Cope.

Tubercular Gecko *Phyllodactylus tuberculosus* Wiegmann

(Fig. 24, p. 65; Fig. 26, p. 68; Pl. 5)

Range. Baja California northward to extreme southern central California (San Diego and Imperial counties). Type locality—California. (Map 38, p. 511.)

Size. Moderate, reaching a snout-vent length of 65 mm. ($2\frac{1}{2}$ in.). The tail is so very fragile that specimens with complete, original tails are uncommon. It is very quickly regenerated when broken, and the regenerated part looks very much like the original; it usually is more swollen and not so conspicuously pigmented, and the scales are of uniform size except below, where they are very broad. The original, complete tail is usually a little longer than the body, but regenerated tails are usually shorter.

Color. Pale gray to yellowish white above, in life appearing somewhat translucent. Dark gray or slate markings on the back tend to form 7 or 8 crossbands on the back; these bands are very irregular, not sharply defined, and usually broken medially. The limbs and head have irregular markings of similar color above. The supralabials are pigmented. A dark line extends from the loreal region through the eye to a point above the ear; it is bordered above and below by a broad light line. The ventral surfaces may be uniformly white or stippled with brown.

Scalation. Much as shown in Fig. 26. The dorsal scales very small, somewhat tubercular, becoming a little larger laterally and merging with the larger, flat, ventral scales. Numerous scattered, enlarged, protruding, keeled scales on the back, arranged in about 7 rows on each side. The scales on the head nearly uniform, small, a little larger on the snout; a series of large labials, decreasing in size posteriorly and

Pl. 5. *Phyllodactylus tuberculosus.* Mountain Spring, Imperial County, California. Courtesy of J. R. Slevin.

disappearing below or immediately behind the eye; mental large, bordered posteriorly by 2 scales in contact with each other medially; no eyelids; pupil vertical; ear opening distinct. Each digit terminating with an enlarged, flattened, double pad, between the two parts of which may be seen the claw (Fig. 24). No femoral or preanal pores. Tail with a few rows of enlarged scales above, but these smaller than those on body.

Recognition Characters. No other lizard of the United States has 2 enlarged, conspicuous, more or less quadrangular, flat pads at the tips of the toes.

Habitat. These lizards are typically found about boulders, usually on hillsides, in semiarid or arid regions. They inhabit boulders with cracks in which they can hide during the day.

Habits. Creatures of the night, these curious lizards are rarely seen during the day—and even then only toward dusk. They emerge at dark from the cracks in which they hide during the day and move about on the rocks searching for small, night-crawling insects. How far they travel at night, whether they return to the same cover each day, and how they find their prey are not known. In the tropics I have frequently seen their close relatives clinging quietly to one spot on a rock for considerable periods of time. When they move they can do so with great speed, disappearing under cover or around a corner like a flash. In the tropics they are common in houses in small rural towns, where they do much good by eating flying insects that abound at night. Frequently they gather about electric lamps, attracted by the insects. Curiously enough, the artificial light does not greatly hinder their movements, although they strictly avoid natural daylight.

Problems. The exact scientific name for this species is in doubt. Here the name *tuberculosus* is arbitrarily restricted to the Californian species pending a definite allocation of the name. The life history has not been studied in any respect.

References. Van Denburgh, 1922, pp. 51–54 (*gen. lit.*).

The Leaf-toed Geckos

Genus *HEMIDACTYLUS* Oken

This genus is much like the last, but the whole basal portion of the digits is strongly dilated and the lamellae are in 2 diagonal rows; most peculiar of all is the terminal portion of the digits, which is clawlike, not flared and round, and projects from within the free distal edge of the toe pad (Fig. 25). There are many species, all provided with preanal or femoral pores in males.

Warty Gecko *Hemidactylus turcicus turcicus* (Linnaeus)

(Fig. 25, p. 65; Pl. 6)

Range. "Sind and Persia west to the borders of the Red Sea; Socotra Island and Italian Somaliland (where it meets with *H. t. macropholis*) north to Egypt and west round Mediterranean Basin to Morocco and the Canary Islands; Cuba; Florida; Yucatán [north to Tamaulipas]. A distribution largely attributable to human agency" (Loveridge). In Florida it is known only from Key West and near Miami. Type locality—Oriente. (Map 1, p. 485.)

Size. Full-grown specimens measure about 60 mm. (2⅜ in.) snout to vent. The tail is a little shorter than the body. The limbs are well developed. The head and body are somewhat flattened.

Color. The ground color varies from nearly white to a light, stippled, brownish gray. Irregular, small dark spots are present on the head, back, and sides of body and tail. On the body they may be elongated transversely; they

Pl. 6. *Hemidactylus turcicus turcicus*. Key West, Florida. Courtesy of Arthur Smith and Robert McCauley.

are usually extended to near the median dorsal line but seldom cross it. The limbs have vague dark markings that tend to form crossbands. The ventral surfaces are white or cream, with a fine, scattered stippling of brown.

Scalation. Dorsal surfaces covered with very tiny granules, but on back there are a number (7 or 8) of irregular rows of conspicuously enlarged, keeled tubercles. A number of similar tubercles are on the dorsal surface of the hind legs, with 2 rows on each side of the tail. The top of the head is covered with tiny granules. The rostral, mental, and labials are well developed. The eye is large, narrowly separated from lip. The pupil is vertical. The ear opening is rather small. The belly scales are flat, smooth, intermediate in size

between the enlarged tubercles and the small granules of the back. Males with 2 to 10 preanal pores. The digits, except for the last phalanx of each, are expanded, with 2 rows of flattened lamellae below; the last phalanx arises well within the margin of the expanded portion and terminates with a prominent claw (Fig. 24).

Recognition Characters. The only lizard in southeastern United States with prominent eyes lacking lids, and with digits expanded throughout most of their length for climbing on smooth surfaces, is this curious nocturnal species.

Habitat. These lizards are almost completely confined to human habitations in the Western Hemisphere.

Habits. The warty gecko, like practically all other geckos, emerges only at night, when it wanders about on walls and slanting ceilings. The food consists of small insects. In captivity these lizards eat ants and termites, existing for long periods on this diet. In tropical America, where they are common in and near port towns, they are usually dreaded as poisonous creatures. Actually they are quite harmless and delicate. Carr reports finding two eggs in dry dust under a board in an abandoned stable on June 16.

Problems. The taxonomy of this species has been rather well studied, but the life history remains a mystery.

References. Boulenger, 1885, p. 126, description (*gen. lit.*); Carr, 1940, p. 70, brief notes (*Fla.*); Loveridge, 1941, pp. 245–247, brief taxonomic notes (*Fla.*).

The Least Geckos

Genus *SPHAERODACTYLUS* Wagler

This is a genus of numerous species; all, however, are very diminutive, with pointed heads. They tend to frequent human habitations. The markings and scutellation are very diverse. Details of the scutellation of a typical species are shown in Fig. 27. The chief morphological character is the single, tiny, round pad at the tip of each digit, with a tiny claw at one side or the other. There are no femoral or preanal pores. All members lay eggs, which are curiously hard-shelled, like birds' eggs. Some emerge during the day as well as at night.

KEY TO SPECIES OF *SPHAERODACTYLUS*

1. Dorsal scales rather large, strongly keeled, overlapping, about 10 or 12 equalling distance from snout to ear, larger than ventral scales (Fig. 28) .... *notatus* (p. 75).
   Dorsal scales small, granular, smaller than ventral scales (Fig. 27C) .... *cinereus* (p. 73)

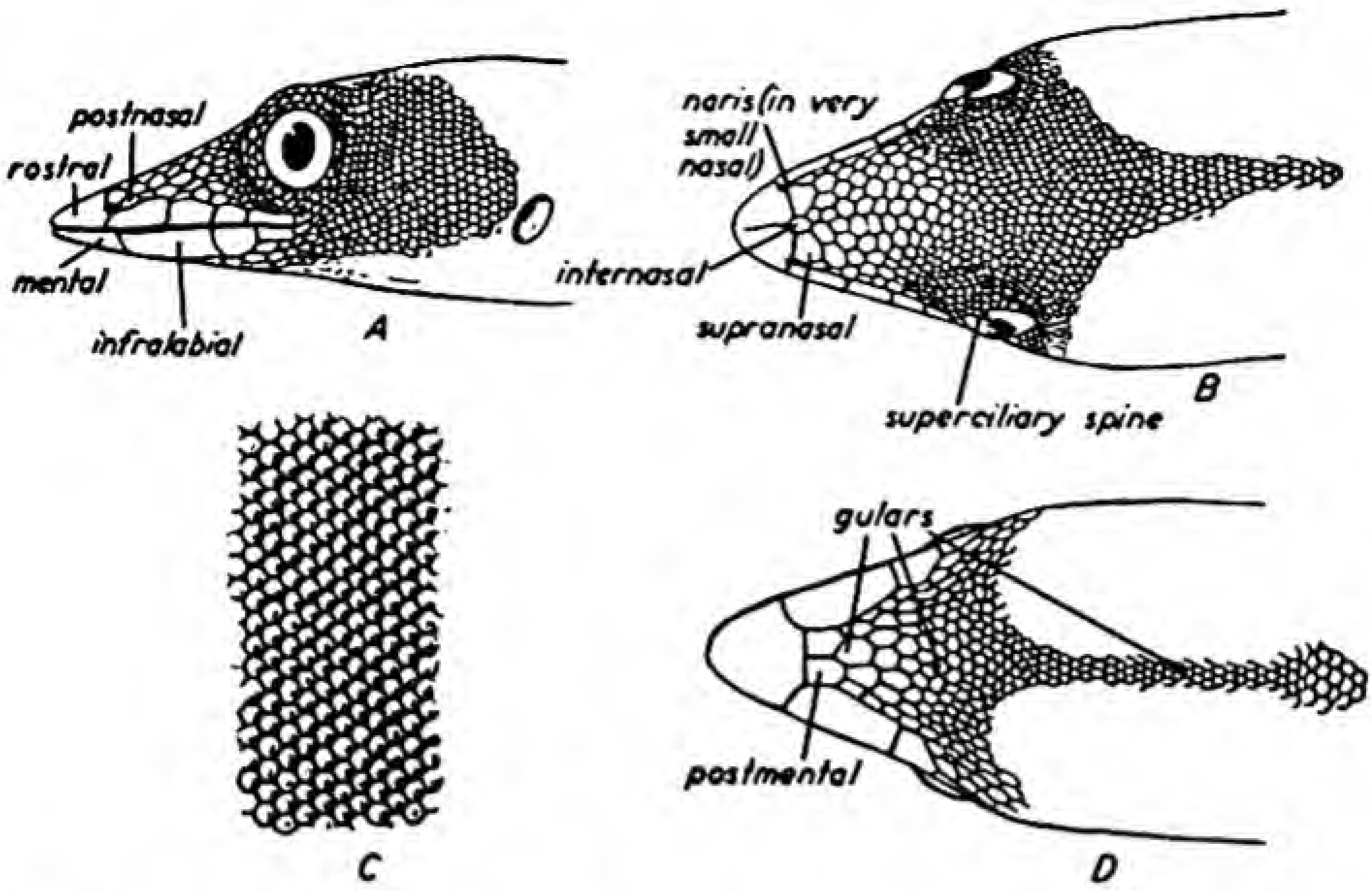


FIG. 27. Typical scutellation in *Sphaerodactylus*, from *S. cinereus*, Island of Pines (A, B, D) and Cabo San Antonio, Cuba (C). A, side of head; B, top of head; C, patch of dorsal scales; D, underside of head. From Barbour.

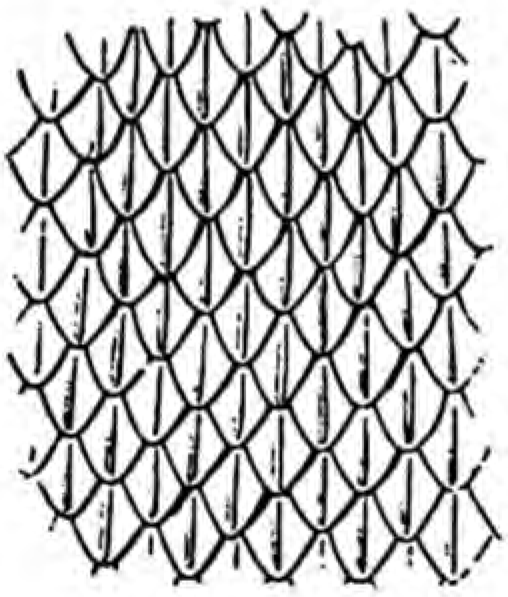


FIG. 28. *Sphaerodactylus notatus*, patch of dorsal scales. From Barbour.

Ashy Gecko *Sphaerodactylus cinereus* Wagler

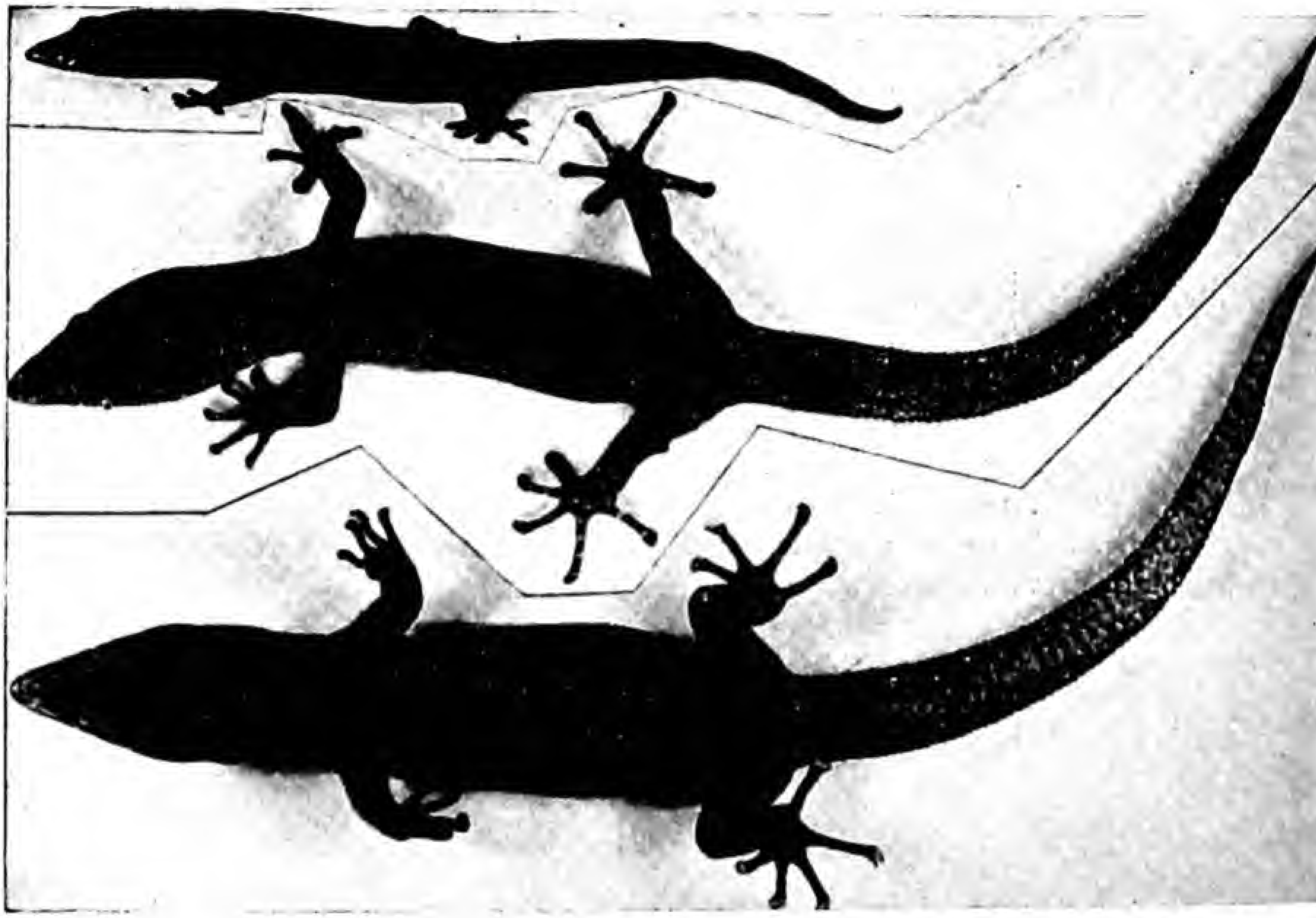
(Fig. 23, p. 65; Fig. 27; Pl. 7)

Range. Haiti, Cuba, Isla de Pinos; Key West and Key Largo, Florida. Probably introduced into Florida. Type locality—Haiti. (Map 9, p. 491.)

Size. A large adult measures 35 mm. (1⅜ in.) snout to vent, and the tail 41 mm. (1½ in.). The limbs are well developed but not large. The snout is elongate and rather flattened.

Color. This is a rather prettily marked species. The dorsal color is reddish

brown to gray-brown; numerous tiny, light yellow spots are scattered over the entire surface of the back and on the limbs. Anterior to the shoulders the spots tend to fuse into short, longitudinal streaks, and on the head may form well-defined, parallel lines. The tail becomes light toward the tip and may have scattered light spots or a somewhat lined pattern. The ventral surfaces



Pl. 7. *Sphaerodactylus cinereus.* Key West, Florida. Courtesy of Arthur Smith and Robert McCauley.

are finely stippled with brown, but appear a nearly uniform cream to the naked eye. A stippling with brown is more prominent laterally on the throat.

In young specimens the body is marked with red transverse bands.

Scalation. See Fig. 27. The tips of the digits have a single, enlarged pad, on one side of which a claw may be seen, more or less protected in a sheath; all the claws are on the anterior edge of the pad, except that on the fifth finger, which is on the posterior edge. Dorsal and lateral scales weakly keeled, scarcely overlapping; ventral scales larger, flat, about like dorsal scales on tail; subcaudal scales very irregular, some widened and others not. Dorsal head scales small, those on snout flat; eye large; pupil vertical; a small, black superciliary spine above eye, which is large; rostral large, grooved posteriorly; naris pierced between rostral, first supralabial, and supranasal; supranasals separated medially; labials distinct, greatly decreasing in size posteriorly; a large mental. Ear opening small. No femoral or preanal pores.

Recognition Characters. The small size, the large and lidless eyes, the small

round pad at the tip of each digit, and the small dorsal scales identify this species. The tiny light spots that tend to form a lined pattern are also characteristic.

Habitat. Found about habitations and in woods.

Habits. Nocturnal, like most other geckos.

The eggs are laid in August in rock piles and trash heaps; they are slightly larger than those of *notatus* but show no other superficial differences. The young are very different from the adult, the body being marked with red transverse bands. The immature form at one time held specific rank (*S. elegans* MacLeay); Barbour (1921) suggested its true status. Strangely enough, although I have examined between sixty and seventy young and adults of this species, I have never come across a specimen which appeared to be intermediate between the young and adult color phases (Carr).

If the eggs of this species and the following are like those of a tropical species with which I am familiar (*S. glaucus*), the shells are very fine and brittle, more like tiny bird eggs than like the usual leathery reptile-egg coverings.

Problems. The life history of this species is practically unknown.

References. Barbour, 1921, pp. 233–234, pl. 2, fig. 4, pl. 12, figs. 1–4 (*Fla.*); Carr, 1940, p. 71 (*Fla.*).

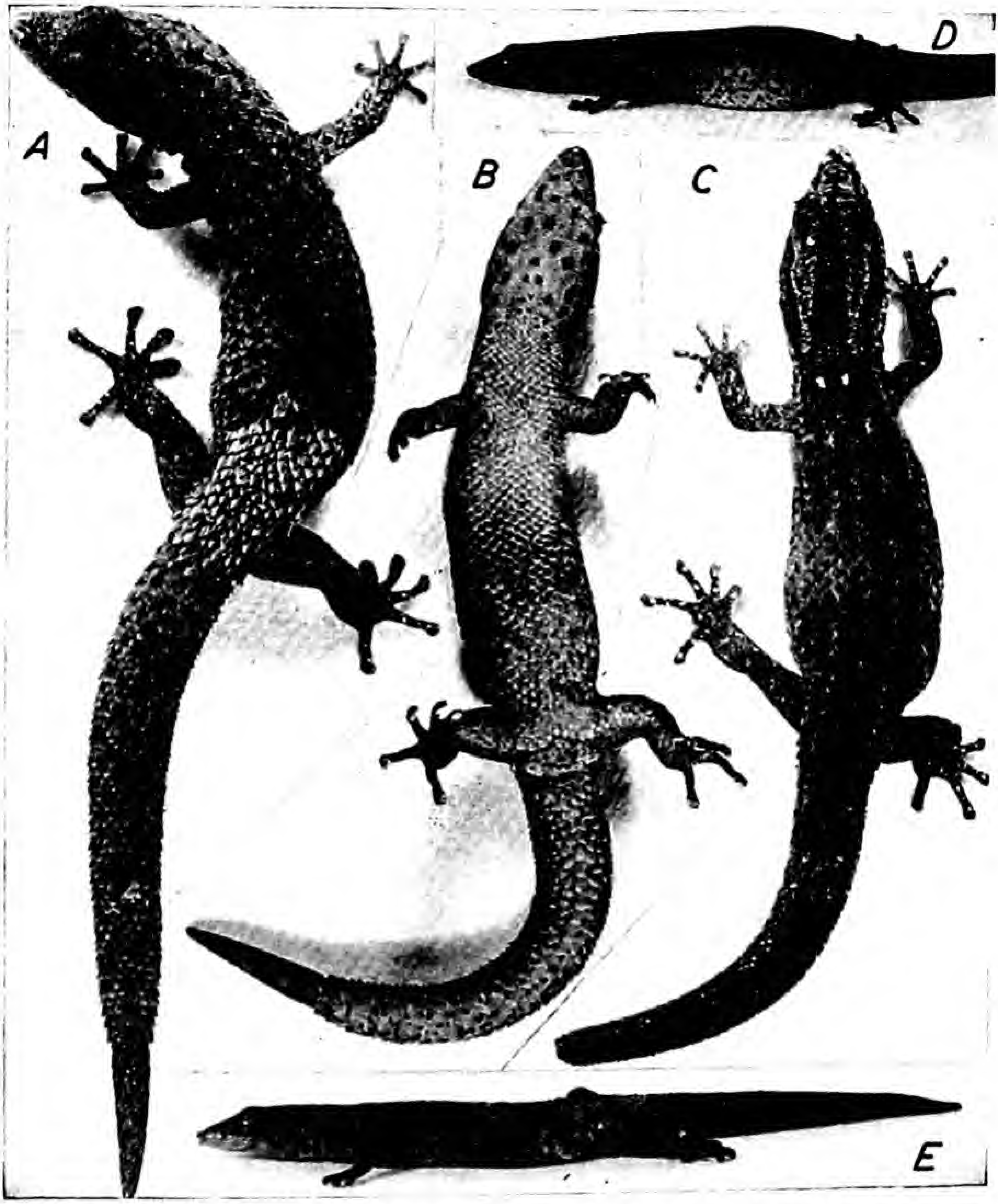
Reef Gecko *Sphaerodactylus notatus* Baird

(Fig. 10, p. 62; Fig. 28, p. 73; Pl. 8)

Range. Bahama Islands, Cuba, and southern Florida (Collier, Dade, and Monroe counties). Type locality—Key West, Florida. (Map 11, p. 492.)

Size. A very diminutive species, large adults measuring about 28 mm. (1⅛ in.) snout to vent. The tail, when complete, is very slightly shorter than the body. The limbs are well developed. The snout is pointed and a little flattened.

Color. Two patterns are common in this species. In one pattern indistinctly outlined, small, dark spots are scattered on the head and body; they are largest anteriorly and become indistinct toward the middle of the body. In the other pattern 3 broad dark stripes, each lighter in the middle, are present on the neck; these stripes disappear toward the middle of the body but remain very distinct on the head, where they rapidly become narrow anteriorly; the median stripe reaches the rostral, while the other two reach only the eye; a narrow dark stripe follows the canthus, and another short stripe extends posteriorly from the upper border of the eye; 2 other narrow dark stripes radiate posteriorly from the eye, one passing above and the other passing below the ear opening. Some specimens may have a pattern intermediate between these two extremes, with the spots somewhat fused in a linear pattern; others entirely lack dark markings above.



Pl. 8. *Sphaerodactylus notatus.* Key West, Florida. A, B, E, male; C, D, female. Courtesy of Arthur Smith and Robert McCauley.

The ventral surfaces are cream, lightly stippled with brown. Some specimens have distinct, scattered, dark spots in the gular region.

Scalation. Except for body scales, much as in Fig. 27. Dorsal scales on body large, keeled, pointed, a little larger than the smooth belly scales (Fig. 28); on the neck the dorsal scales become smaller and grade into the very small, obtusely keeled scales on top of the head. The tail scales are keeled dorsally,

smooth ventrally; the median subcaudals are irregular, enlarged, but not widened (except on regenerated parts, where the median scales are greatly widened). Rostral about as large as mental, grooved above; labials greatly decreasing in size posteriorly; no eyelids; pupil vertical; a tiny black spine above eye; ear opening small.

Recognition Characters. The large, lidless eyes, the small size, the rather large keeled scales on the back, and the small round pad at the tip of each toe identify this species. It differs from the ashy gecko, its closest relative, by having large, keeled scales on the back, while the other has small, granular ones. This species, moreover, has a different pattern, with dark stripes or a uniform color on the neck.

Habits and Habitat. Barbour and Ramsden say:

> It is found commonly in the woods in Cuba and the Bahamas, but sometimes enters houses, living by day hidden in some nook or cranny. When collecting insects in the forest, and tearing open rotten logs, one often meets with small single eggs, pure white, and about 3 x 5 mm. in size, and as the obvious parent is so often near by there cannot be much doubt but that these are the eggs of Sphaerodactylus. That they are laid singly is of interest, not only because this is also the habit of Anolis [1] but because many other geckos both of the Old World and the New, e.g. Ptychozoon and Aristelliger, lay their eggs in pairs. The pairs are evidently laid while soft and sticky and usually are so closely approximated as to indent one another. They are stuck fast to the surface of some crevice on, or in the hollow of, a large tree. They take a long time to hatch.

Carr states that in Florida these lizards are

> crepuscular; I found them numerous and very active in the fine hardwood hammock on Lignum Vitae Key at noon. Occasionally they may be found under rocks and driftwood along the key beaches. . . . The eggs are laid from June to August, singly or by twos or threes in rock piles and under boards; they are oval, and average 6 by 4.5 mm. The young are 23–25 mm. long and like the adult in pattern and coloration.

Problems. Observations on the life history of this species are very scant.

References. Barbour and Ramsden, 1919, pp. 125–126, pl. 3, fig. 2 (*Fla.*); Carr, 1940, pp. 70–71 (*Fla.*).

The Ground Gecko Section: SUBFAMILY EUBLEPHARINAE

Six genera comprise this little subfamily; two occur in Africa and southwestern Asia and the others are American. Probably not over twenty-five species are known for the whole group. They are distinguished as a group from the Gekkoninae by having the parietal bones fused together and functional

[1] [Not in *A. carolinensis*, which usually lays 2 eggs.—H.M.S.]

eyelids. A few true geckos have rudimentary eyelids, and one genus has an upper lid sufficiently well developed almost completely to cover the eye.

The ground geckos lack pads on the digits and are largely terrestrial.

The American Ground Geckos

Genus *COLEONYX* Gray

These lizards scarcely grace the name of gecko as they lack digital pads and have eyelids. The limbs are weak, the skin very delicate. There are a few preanal pores. The claws are concealed between 2 lateral, vertical plates (Fig.

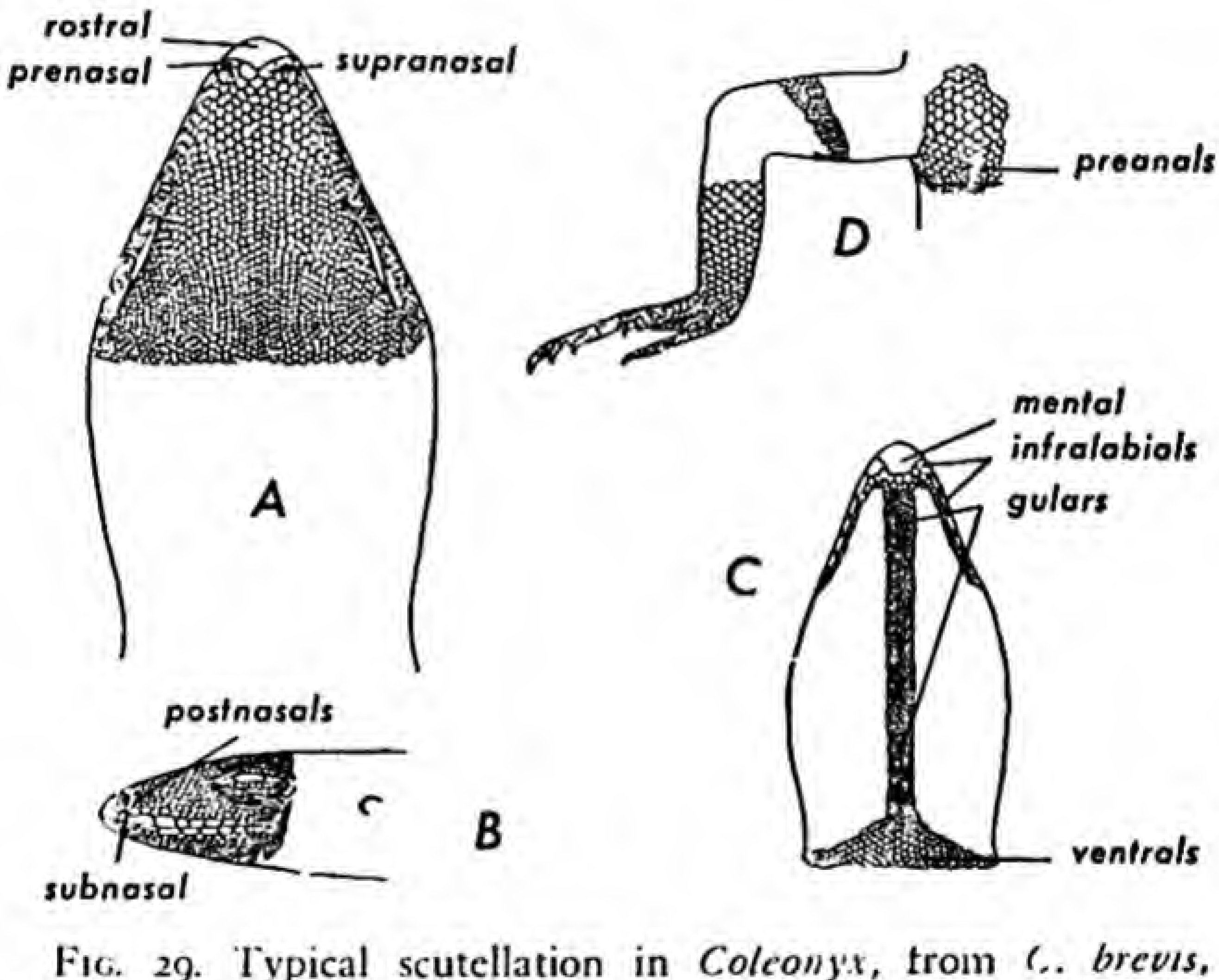


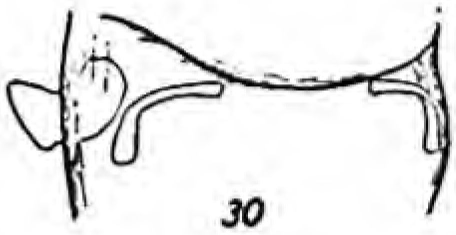
FIG. 29. Typical scutellation in *Coleonyx*, from *C. brevis*, Helotes, Texas. A, top of head; B, side of head; C, underside of head; D, ventral view of right hind leg and anal region. From Cope.

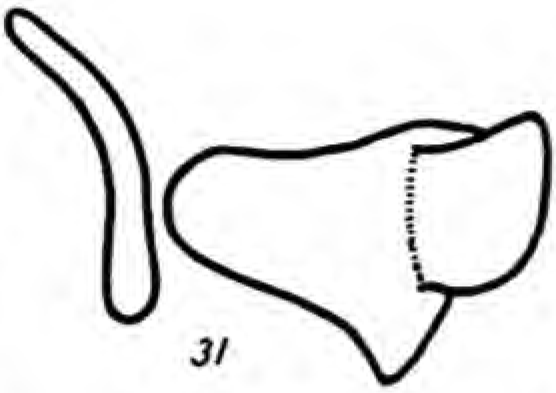
19). A pair of cloacal bones lies under the skin on each side of the base of the tail just back of the anus (Fig. 30). Details of the scutellation of a typical species are shown in Fig. 29.

KEY TO SPECIES OF *COLEONYX*

1. Cloacal bones, or their skin ridge, broad at tip (Fig. 31); preanal pores 4 to 6, usually not in contact medially (Fig. 33); dorsal color pattern of adults consisting of small dark spots scattered profusely,

the crossbands fading out gradually in older specimens; maximum snout-vent length about 58 mm. .... *brevis* (p. 80)





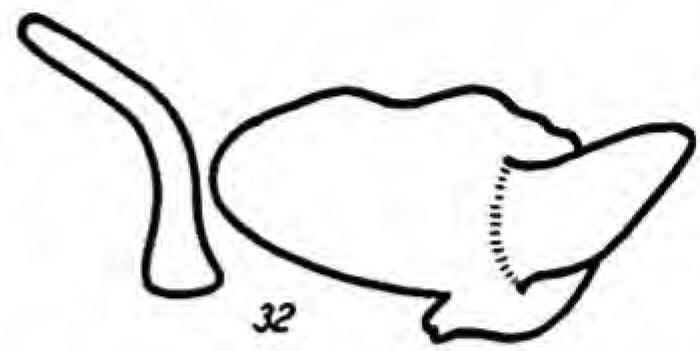


FIG. 30. *Coleonyx brevis*, ventral view of anal region showing relation of cloacal bones to anal slit. From Noble.

FIG. 31. *Coleonyx brevis*, cloacal bones of right side. From Smith.

FIG. 32. *Coleonyx variegatus*, cloacal bones of left side. From Smith.

Cloacal bones, or their skin ridge, pointed and straight (Fig. 32); preanal pores 6 to 10, in contact medially (Fig. 34); dorsal color pattern of adults much like that of young, with large dark spots ap-

FIG. 33. *Coleonyx brevis*, ventral view of anal region. From Smith.

FIG. 34. *Coleonyx variegatus*, ventral view of anal region. From Smith.

pearing between the bands, and the latter in old specimens breaking up into large spots, not fading out as in *brevis*; maximum size about 70 to 73 mm. snout to vent .... *variegatus* [2] (p. 83)

[2] In a recent study by Klauber (*Trans. San Diego Soc. Nat. Hist.*, vol. 10, no. 11, 1945, pp. 133–216, maps 1–2) entitled "The geckos of the genus Coleonyx with descriptions of new subspecies," the range, variation, and characters of the genus, its species, and its subspecies are treated in detail. No subspecies of *Coleonyx brevis* are defined, but seven are proposed for *Coleonyx variegatus*. Of the latter seven, four occur in the United States. Klauber distinguishes them as follows:

1. Preanal pores in the males usually number 8 or more; transverse dark body bars in adults equal to or narrower than light interspaces, their edges darker; head conspicuously spotted or mottled; southeastern Arizona from the vicinity of Casa Grande, Pinal County, south to the Mexican border and northeast to Roosevelt

Lesser Ground Gecko *Coleonyx brevis* Stejneger

(Figs. 17–19, p. 63; Fig. 29, p. 78; Figs. 30–31, 33, p. 79; Pl. 9)

Range. Southeastern New Mexico, southwestern and southern Texas, and northern Mexico (Nuevo León, Coahuila, and Durango). Type locality—Helotes, Bexar County, Texas. (Map 1, p. 485.)

Size. A small lizard reaching its maximum snout-vent length (females) at about 58 mm. (2¼ in.). Males are but slightly smaller, the largest measuring 56 mm. The tail, when unregenerated, is just about the same length as the head and body, but specimens with original and complete tails are seldom found. Usually the tails are distinctly shorter than the body when regenerated. The legs are small, about equal, and weak.

Color. Young and half-grown specimens (i.e., those less than about 40 mm. or 1½ in. snout to vent) have 5 broad, dark to light reddish-brown bands (chestnut in life) across the back, fading on the sides of the body and not reaching the belly. These bands are about twice or three times as broad as the light (cream or sulphur yellow) areas between them. The anterior light band is crescentic in shape and extends toward the labial region. There are about 8 similar but darker bands on the tail; the tail bands are complete, although they tend to be lighter on the ventral surface. The head is perhaps a little

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Reservoir, thence southeastward to the New Mexican line at Duncan, Greenlee County .... *variegatus bogerti*
(Tucson Ground Gecko)

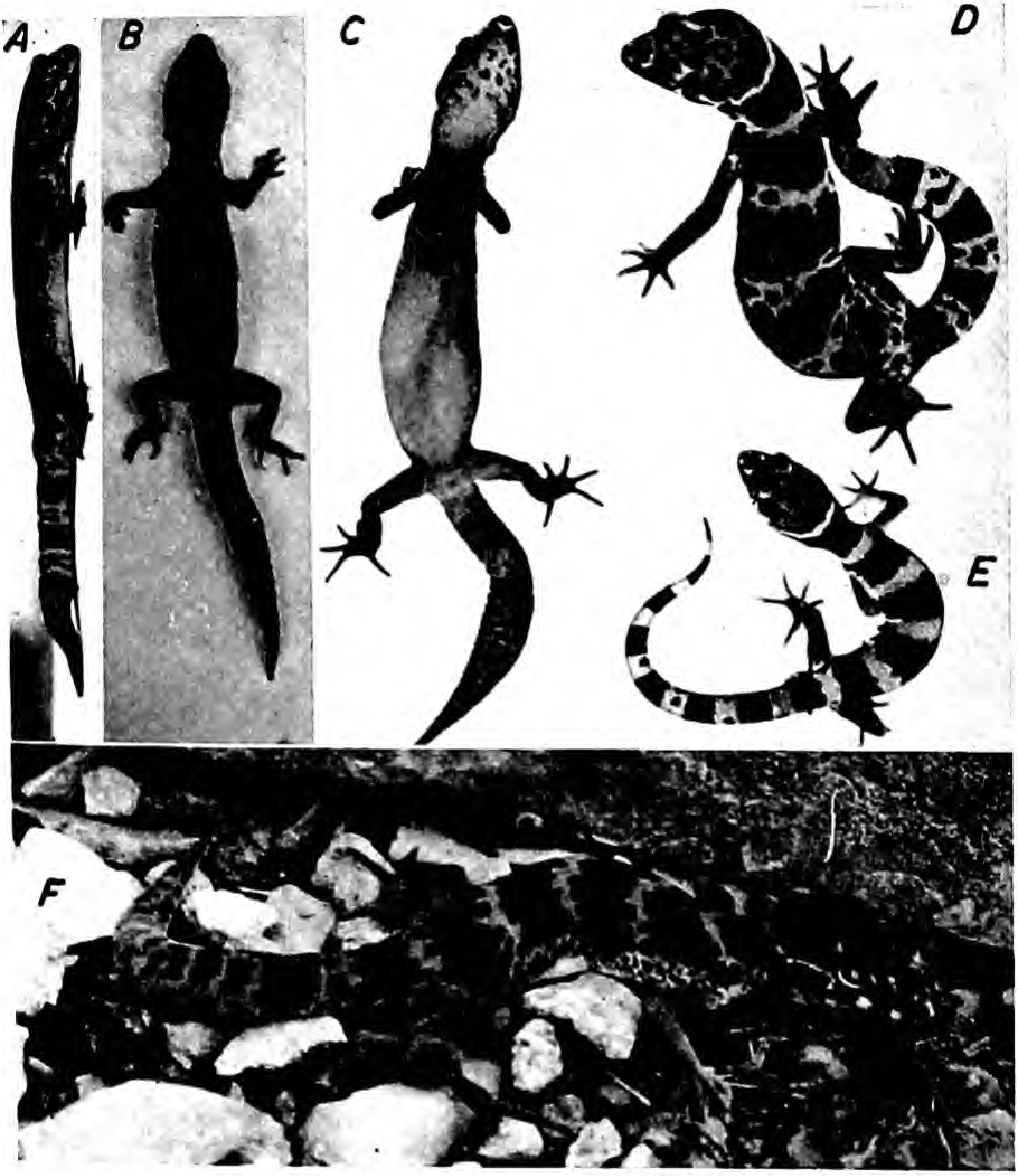
Preanal pores in the males usually number 7 or less 2

2. Adults with the dark transverse body bars considerably wider than the interspaces, and their anterior and posterior borders often highly irregular, often confluent with spots in the interspaces; Washington County, Utah, extreme northwestern Mohave County, Arizona, and northeastern Clark County, Nevada .... *variegatus utahensis*
(Utah Ground Gecko)

Adults with the dark transverse body bars about equal to or narrower than the light interspaces, or sometimes obsolete and replaced by uniform spotting 3

3. Dark body bands unicolor in adults; top of head unicolor; nuchal light loop narrow and clear; coastal and Pacific slopes of southern California and northern Baja California from the San Gabriel Mountains, Los Angeles County, south to the west slope of the San Pedro Martir Mountains of Baja California; Cedros Island .... *variegatus abbotti*
(San Diegan Ground Gecko)

Dark body bands in adults with lighter centers, producing a double-barred effect, or bars obsolete and replaced by spotting; top of head spotted; nuchal light loop irregular or obsolete; deserts of southeastern California from northern Inyo County southward; southern Nye and southwestern Clark counties, Nevada; Arizona from the central mountain area west and south, but not including the section east of the line Casa Grande–Covered Wells; extreme northeastern Sonora, and extreme northwestern Baja California .... *variegatus variegatus*
(Desert Ground Gecko)



Pl. 9. *Coleonyx brevis.* A, Helotes, Texas; male. B, no locality; Smith photograph. C, D, Helotes, Texas; female. E, Helotes, Texas; young. F, Devil's River, Texas; male; Gloyd photograph.

lighter in color than the dark bands, and the lips are barred. The legs are a uniform light brown above. The ventral surfaces are cream (they are said to be flesh- or rose-colored in life) except for the tail rings and a few dark marks about the lips.

At a size of about 40 to 45 mm. (about 1¾ in.) small dark spots begin to form in the light areas between the bands, and with an added growth of 5 to 8 mm. (¼ in.), the dark bands begin to break up into small dark spots, the

intervening areas becoming gradually lighter in color, until at the size of about 53 mm. (2⅛ in.), the dark crossbands are either entirely absent or are distinguishable only as indefinite dusky areas. This pattern change is evident on the head as well as on the body and tail.

Scalation. See Fig. 29. The skin is very thin and tender, tearing with the slightest rough treatment. The tail is very fragile but reproduces quickly. The pupil is vertical. The head, body, limbs, and tail are covered above by very fine, juxtaposed granules, and the lower parts have scales a little larger that overlap. There are enlarged plates about the lips, but all other head scales are tiny. Eyelids are present. The ear opening is very small. The fingers and toes are rather short, not tapered. Males have a very conspicuous, flattened, broad, little bone (the cloacal bone) projecting outward, upward, and forward from the sides of the base of the tail (Fig. 31). The projecting cloacal bones are present only in males; in females flaps of skin mark their position; each flap is broad, shaped like the tip of the bone as it exists in males. There is a short v-shaped series of preanal pores, difficult to discern in females; the pores number from 4 to 6 and are usually in two separate series, one on each side.

Recognition Characters. The ground geckos are the only lizards in the United States with very fine, granular scales, thin skins, eyelids and digits lacking expansions near the tip. The variegated ground gecko has a somewhat different pattern in adults; it has more numerous (6 to 10) preanal pores that are never separated into two series by small median scales, and the cloacal bone has a pointed tip.

Habitat. These small, pretty lizards are rather well restricted to rocky or canyon areas. Foothills seem to be preferred where they can hide under rocks during the day and forage about on level ground at night. In southern Texas, however, they are also common in the low, earthen hills near the Rio Grande and its small tributaries. Here they seek protection during the day in cracks in the vertical, earthen banks or under the scarce rocks near the low hilltops. They do not occur on flat, unbroken areas.

Habits. Ground geckos are like true geckos, nocturnal in habits. They may emerge from hiding at dusk, but never normally in bright light. During the day they hide in cracks in boulders or earthen banks, or under rocks, and at night they wander several yards from their diurnal quarters, foraging for the small insects that comprise their food. They do not appear to occur high on rough, rocky, steep slopes, but rather near more or less level areas. They seem to be poor climbers, preferring to prowl about upon flat land.

The life history of this species is unknown. Presumably eggs are laid.

Problems. This species offers some of the most attractive possibilities of all United States lizards for life history and habit studies. In fact the life history of no species of the whole family is known in any detail, yet such a history would be of considerable interest, especially as a basis for comparison

with the life histories of members of related families, particularly the true geckos.

References. Smith, 1933, pp. 301–314, pl. 1, text fig. 1 (*gen. lit.*).

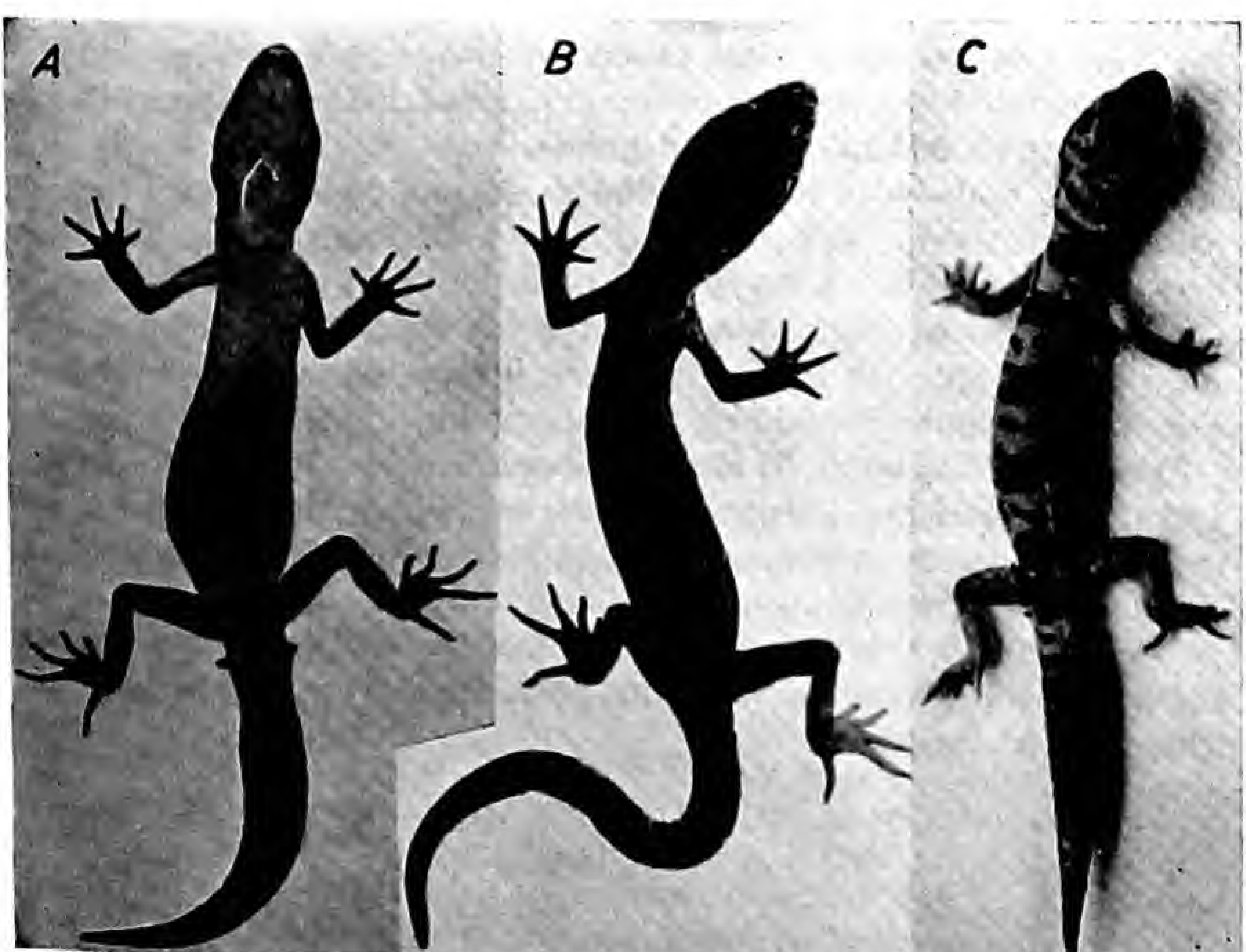
Variegated Ground Gecko *Coleonyx variegatus* (Baird)

(Figs. 32, 34, p. 79; Pl. 10)

Range. Southwestern Utah, Arizona except the northeastern corner, extreme southern Nevada, southern California, and northwestern Mexico in Baja California, Sonora, and the islands of Cedros, San Marcos, and South Santa Ynez. Type locality—Rio Grande and Gila valleys. (Map 1, p. 485.)

Size. A little larger than the lesser ground gecko, females reaching 75 mm. (3 in.) snout to vent, males 68 mm. Tail about as long as head and body. Legs small, weak.

Color. Specimens measuring less than about 50 mm. (2 in.) snout to vent have 5 broad, dark walnut-brown bands on the body, about as wide as the light area of dull Naples yellow between them or a little wider. The anterior



Pl. 10. *Coleonyx variegatus.* A, St. George, Utah; male. B, same locality; female. C, no locality; male. A, B, U.S. Fish and Wildlife Service photographs; C, Smith photograph.

light band is crescentic in shape and extends toward the eye. The head is about the same color as the dark bands on the body. The legs are fawn color above. The edges of the eyelids are white. A dark line, bordered above and below by white, extends from eye to nostril. The tongue in life is a rich pink with a bright red tip (Van Denburgh). Bands on the tail are like those on the body, about 10 in number, and do not extend onto the ventral surface. The ventral surfaces of the head and body are white, and the subcaudal surface is pale lemon yellow. The eye in life is pale grayish yellow, with a network of fine black lines (Van Denburgh). The pupil is vertical.

Specimens a little larger (50 to 53 mm.) show the pattern beginning to break up. This is initiated by the appearance of rather large dark spots laterally in the light bands. As larger size is attained a median light band somewhat darker than the light ground color develops in each dark crossband. The latter then breaks in the middorsal line, first anteriorly, then progressing posteriorly. If the individual attains sufficient size and age, the bars disintegrate entirely to form large spots scattered irregularly over the back. The pattern on the head breaks up into dark spots on a light ground at the same time. It is an interesting fact that in part of its range (i.e., the California coast and upper Sonoran localities) these lizards never reach a large size, and in these the crossbands are very regular. Desert specimens reach the large size, and perhaps a greater age, and thus permit the pattern change to progress further (in breaking up into spots) than the others do.

Scalation. Much as in Fig. 29 of the lesser ground gecko, except that the preanal pores form a perfect v-shaped series not broken medially. The pores vary from 6 to 10. The projecting cloacal bones on either side at the base of the tail are spur-shaped (Fig. 32), not broad and flattened as in the other species. Even females, although lacking the projecting spurs, have rounded flaps of skin where the bones would be if present.

Recognition Characters. These are the same as those for the lesser ground gecko, from which the variegated species is distinguished by the different pattern (evident mostly in specimens over 40 mm. snout to vent), the more numerous preanal pores (6 to 10 instead of 4 to 6), and the continuity of the preanal pore series (Fig. 34) which are broken medially in the former species.

Habits and Habitat. The variegated ground gecko occurs in habitats like those of its related species.

> Near Tucson they seemed to live in colonies near the tops of certain low rolling desert hills near the lower edge of the giant cactus belt. On some of these hills we found six or eight specimens under stones six to twenty inches in diameter (April 8–13), while on other similar hills none could be found, although nearly every suitable stone was turned. Later in the season we could find none, and it is probable that they descend into holes as the ground dries and the weather becomes warmer (Van Denburgh).

However, the variegated species is more ubiquitous than the "lesser" species, apparently, since it has been recorded on the open desert where the only normal shelter is small mammal holes and fallen yuccas; here specimens may be found also under tin cans, old clothes, boards, and scattered stones. In southwestern Utah "These lizards are most commonly found between late March and early May beneath slabs of red sandstone rock. They prefer crevices between rocks to positions where a rock rests directly upon the soil. They are much less often taken in the lava rock of the area, probably because of the less numerous crevices found in such situations" (Hardy). At night they can be found wandering about on the desert, and driving slowly along highways after dark reveals them in considerable numbers. With the aid of headlights Klauber reports finding as many as thirty in one evening. In this manner specimens may be "found in every kind of desert habitat and up to an elevation of at least 4000 ft.; in rocks, bush, cacti and on sandy flats, although probably most common in the latter" (Klauber). They reach their maximum activity in spring (May), and perhaps about 8:30 or 9:00 P.M., depending upon the season and thus upon the temperature fall during the night. Their optimum temperature is between 80° and 84° F. (air temperature); at lower or higher temperatures activity is inhibited. They very rarely emerge during the day, except sometimes at dusk, and even then probably only because of peculiar conditions. Hibernation occurs from October to March; and 59° F. is the lowest temperature at which they have been observed active on their own initiative.

Among their enemies are counted nocturnal desert snakes, particularly *Phyllorhynchus*, the leaf-nosed snakes, which eat not only adults but their eggs as well. Larger lizards also prey upon them; an alligator lizard (*Gerrhonotus m. scincicauda*) ate one in captivity.

The food consists of insects of many types, perhaps chiefly beetles and spiders, and of all sizes up to those which must be forced down by serpentine movements of the jaws. They eat readily in captivity, and though never very pugnacious, pass through a brief period before becoming tame. When first caught they frequently emit a feeble squeak. During the winter (December 4) specimens were found a few inches below the surface of the ground when land was graded. Hardy has taken them during December in holes in gravel along washes.

"These lizards invariably eat their cast skins. The skin loosens in large patches and is seized in the mouth and swallowed as it comes away from the body. They carefully clean the old skin from each foot and digit, sometimes giving the appearance of removing a pair of tight gloves by seizing the tips of the fingers between the teeth" (Kauffeld).

Little has been recorded of the life history. Ortenburger notes that a female laid two eggs in late August. Hardy believes that breeding does not occur

during the year following hatching, and that the season begins in late April and May.

Problems. The life history of this species, as of the "lesser" species, should be investigated. Many of its habits are fairly well known.

References. Hardy, 1944, pp. 71–73 (*Utah*); Kauffeld, 1943, p. 344; (*Ariz.*); Klauber, 1939, pp. 34–36, 83–84 (*Ariz.*); Smith, 1933, pp. 301–314, pl. 1, text fig. 1 (*gen. lit.*); Van Denburgh, 1922, pp. 58–61, pl. 1 (*gen. lit.*).

The Iguanids

Family IGUANIDAE

This is by far the largest family of lizards of the New World, to which it is almost completely restricted. There are two genera in Madagascar and one in Polynesia, but otherwise the family is restricted to this hemisphere. Here, practically all commonly observed lizards belong to this dominant family. Fourteen of the thirty genera of lizards of the United States and about three fifths of the species are iguanids.

There is a great variety of form in this family, which includes the small anoles, the bizarre, sedentary, horned lizards, the swift-running, elongate, crested lizards, and the giant iguanas. Some species (usually large ones) are herbivorous; many others are insectivorous; one genus in the Galápagos Islands, off the northern Pacific coast of South America, is semimarine, living on sea algae. Some are completely terrestrial, others almost completely arboreal. All except some of the horned lizards and rough-scaled lizards (*Sceloporus*) lay eggs.

The most characteristic feature of the family is the nature of the teeth, which lie in grooves on the inner surface of the jaws (pleurodont). The Old World counterpart of this family (Agamidae), which includes members very much like most of those of the Iguanidae, is characterized by having the teeth situated on the crest of the bone, rather than on the side. The splenial bone of the lower jaw is absent or greatly reduced in the Agamidae, well developed in the Iguanidae. As the iguanids are largely restricted to this hemisphere, so are the agamids restricted to the Eastern Hemisphere (with no exception). A characteristic habit is that of bobbing (see p. 45). The lamellae under the toes and fingers have numerous keels, generally 3 or 5.

KEY TO GENERA OF IGUANIDAE

1. Ventral lamellae on next to last phalanx of digits expanded laterally, padlike (Fig. 35); no femoral pores . . . . *Anolis* (p. 93)
   Ventral lamellae on digits not padlike, although fringelike in some; femoral pores present, conspicuous in males, less well defined in females 2

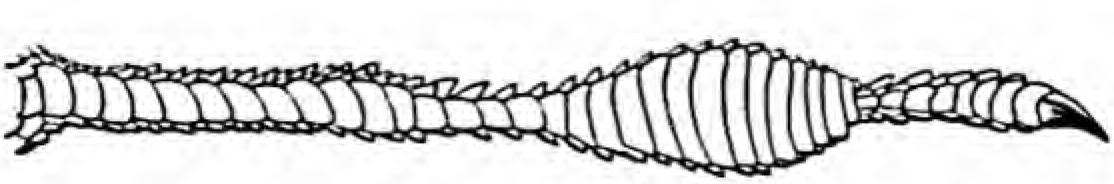
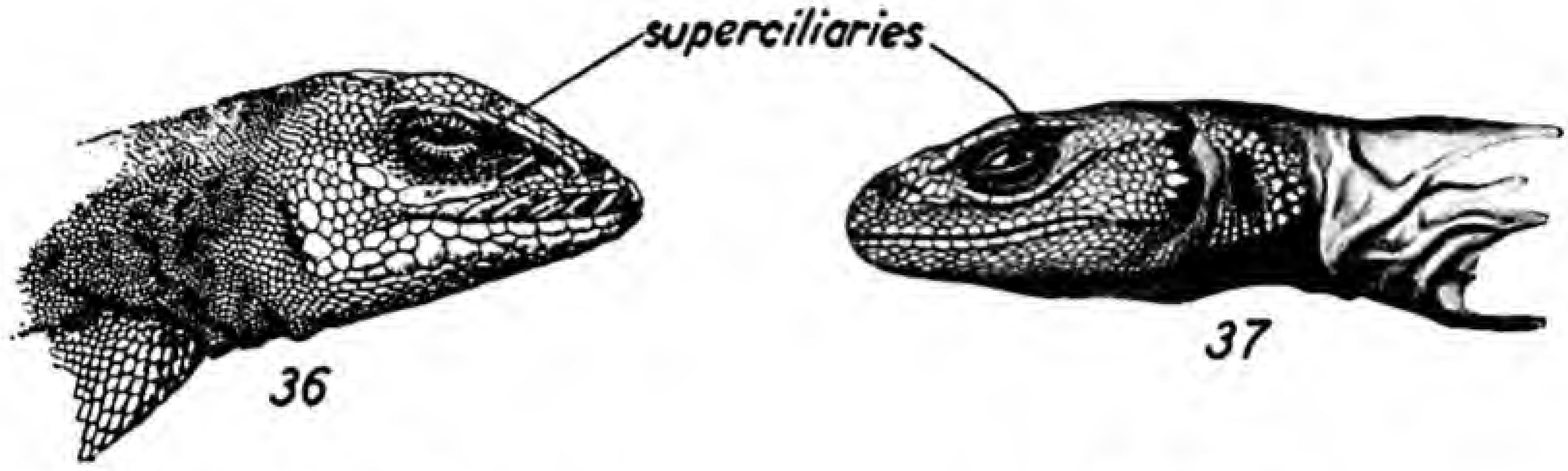


Fig. 35. *Anolis stejnegeri*, ventral view of fourth toe. From Burt.

2. Head bearing bony spines posteriorly, or elevated somewhat in a projecting ridge .... *Phrynosoma* (p. 287)
   Head normal, not produced posteriorly in a bony ridge or in spines . 3
3. Superciliary scales not imbricate, but juxtaposed, like other scales on head (Fig. 37); rostral subdivided, with a median suture reaching lip (Fig. 38) .... *Sauromalus* (p. 108)
   Superciliary scales strongly imbricate, large (Fig. 36); rostral not divided, no median suture reaching lip (Fig. 39) 4



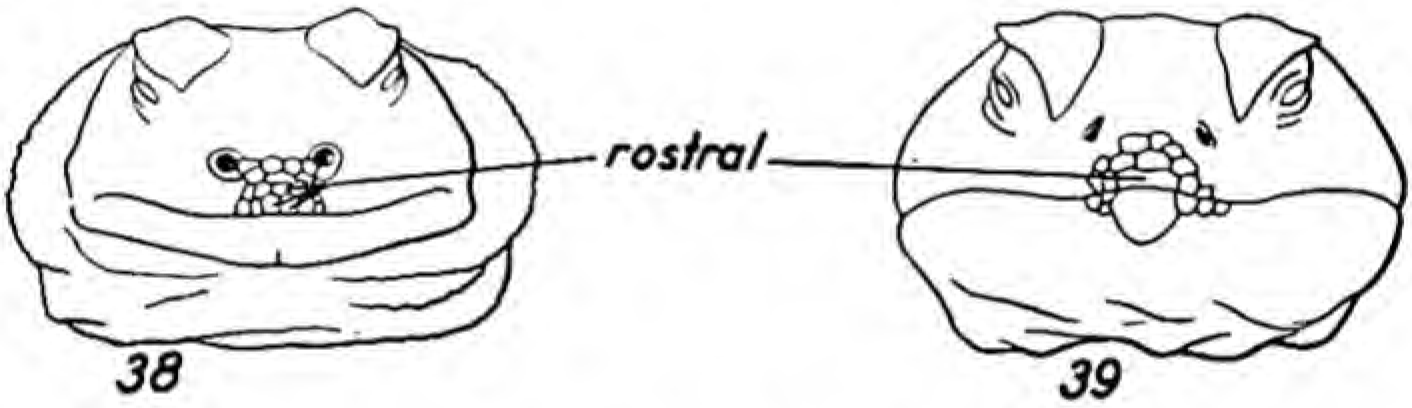


FIG. 36. *Holbrookia texana,* side of head. From Schmidt.
FIG. 37. *Sauromalus obesus,* side of head. From Bocourt.
FIG. 38. *Sauromalus obesus,* end of snout. From Burt.
FIG. 39. *Crotaphytus reticulatus,* end of snout. From Burt.

4. Sutures between supralabials diagonal, not vertical (Fig. 40); mental very small, bordered posteriorly by a median postmental (Fig. 41) 5
   Sutures between supralabials vertical; mental larger, not bordered posteriorly by a median postmental 7

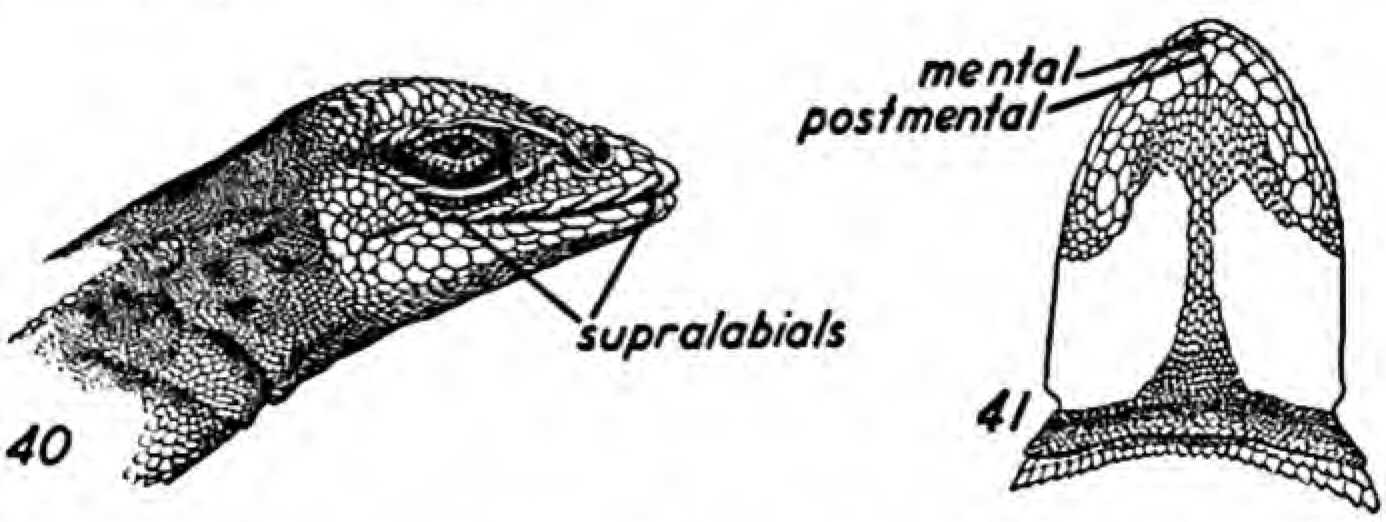


FIG. 40. *Holbrookia maculata thermophila,* side of head. From Schmidt.
FIG. 41. *Holbrookia texana,* underside of head. From Cope.

5. No ear opening .... *Holbrookia* (p. 114)
   A distinct ear opening 6
6. Toes with a conspicuous lateral fringe of spinelike scales separated by tiny scales from ventral lamellae (Fig. 42); interparietal much smaller than ear opening .... *Uma* (p. 148)

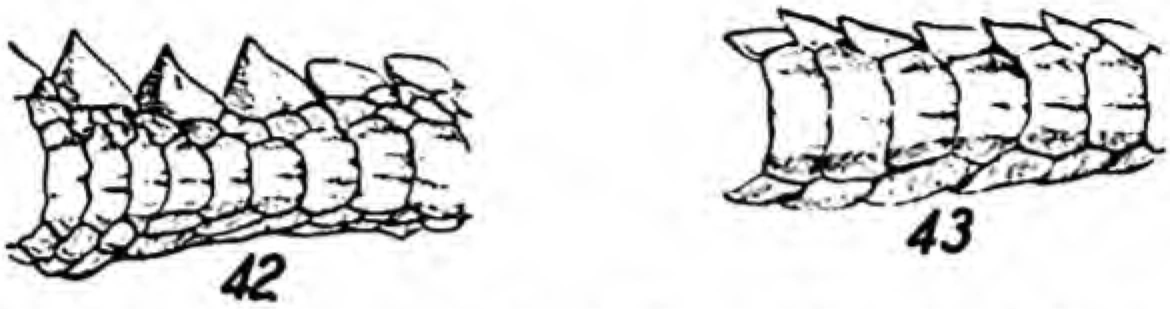


FIG. 42. *Uma,* ventral view of base of fourth toe. From Schmidt.

FIG. 43. *Callisaurus draconoides,* ventral view of base of fourth toe. From Schmidt.

   Toe fringes less conspicuous, not separated from ventral lamellae (Fig. 43); interparietal larger than ear opening .... *Callisaurus* (p. 137)
7. No transverse gular fold (Fig. 44) 13
   A transverse gular fold, marked by granular scales much smaller than those preceding or following the fold (Fig. 45) 8

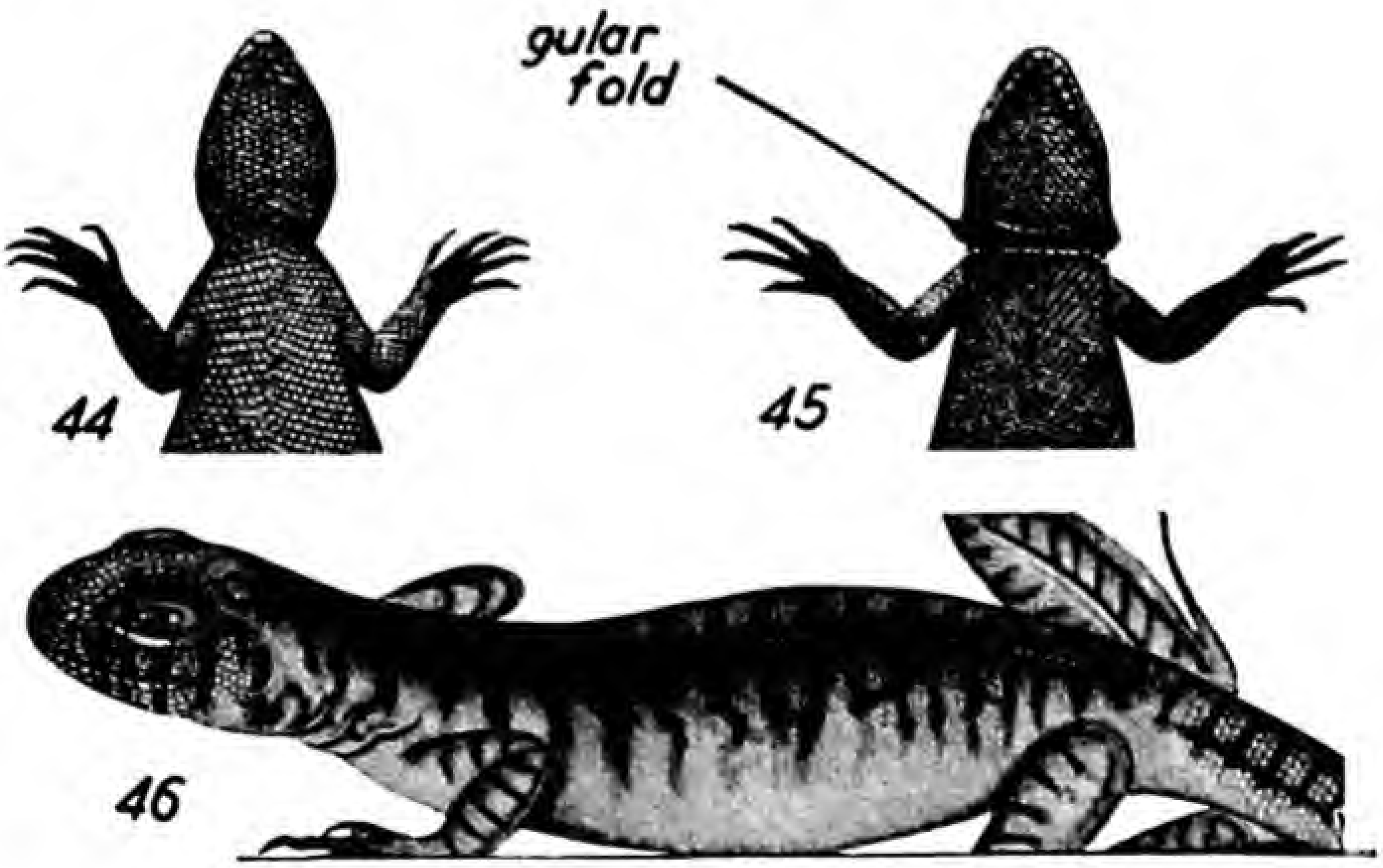


FIG. 44. *Sceloporus graciosus,* ventral view of head and anterior part of body. From Baird and Girard.

FIG. 45. *Uta stansburiana,* ventral view of head and anterior part of body. From Baird and Girard.

FIG. 46. *Dipsosaurus d. dorsalis,* dorsolateral view of head and body. From Baird.

8. A single, median, dorsal, longitudinal series of enlarged scales (Fig. 46) .... *Dipsosaurus* (p. 105)

Scales in vertebral row not conspicuously if any larger than adjacent scales 9

9. Interparietal very large (Fig. 47), larger than ear opening (Fig. 48) 10

Interparietal small (Fig. 49), smaller than ear opening (Fig. 50); caudal scales smaller, not pointed, scarcely overlapping 12

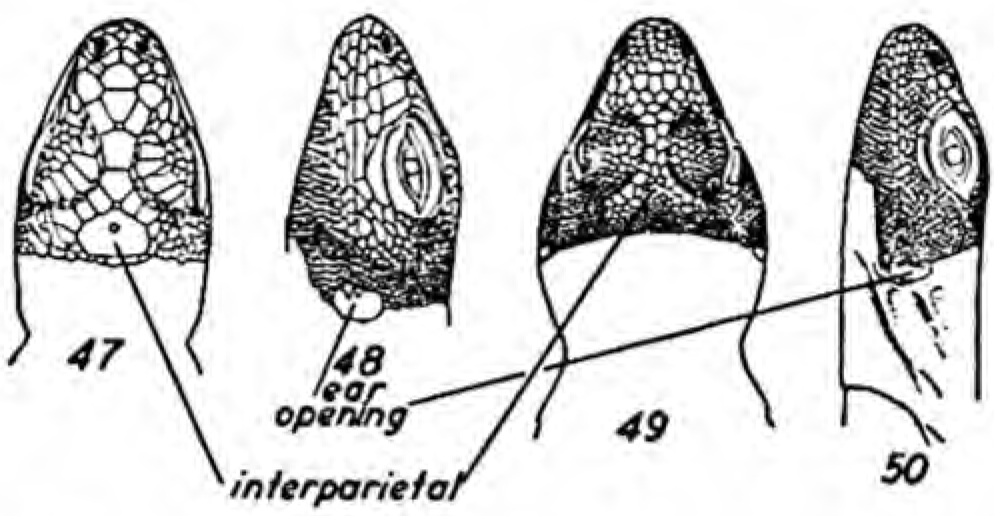


FIG. 47. *Urosaurus graciosus,* top of head. From Cope.
FIG. 48. *Urosaurus graciosus,* side of head. From Cope.
FIG. 49. *Crotaphytus collaris baileyi,* top of head. From Ortenburger, after Cope.
FIG. 50. *Crotaphytus collaris baileyi,* side of head. From Ortenburger.

10. Dorsal scales all small, granular, smooth, very little larger than lateral scales; enlarged supraoculars in more than one row; one or more blackish bars across shoulders; size frequently over 75 mm. (3 in.) snout to vent (Fig. 51) . . . . *Streptosaurus* (p. 175)

Dorsal scales, at least toward middle of back, larger than lateral scales, keeled; enlarged supraoculars in one row; no blackish bars across shoulders; size less than 75 mm. snout to vent 11

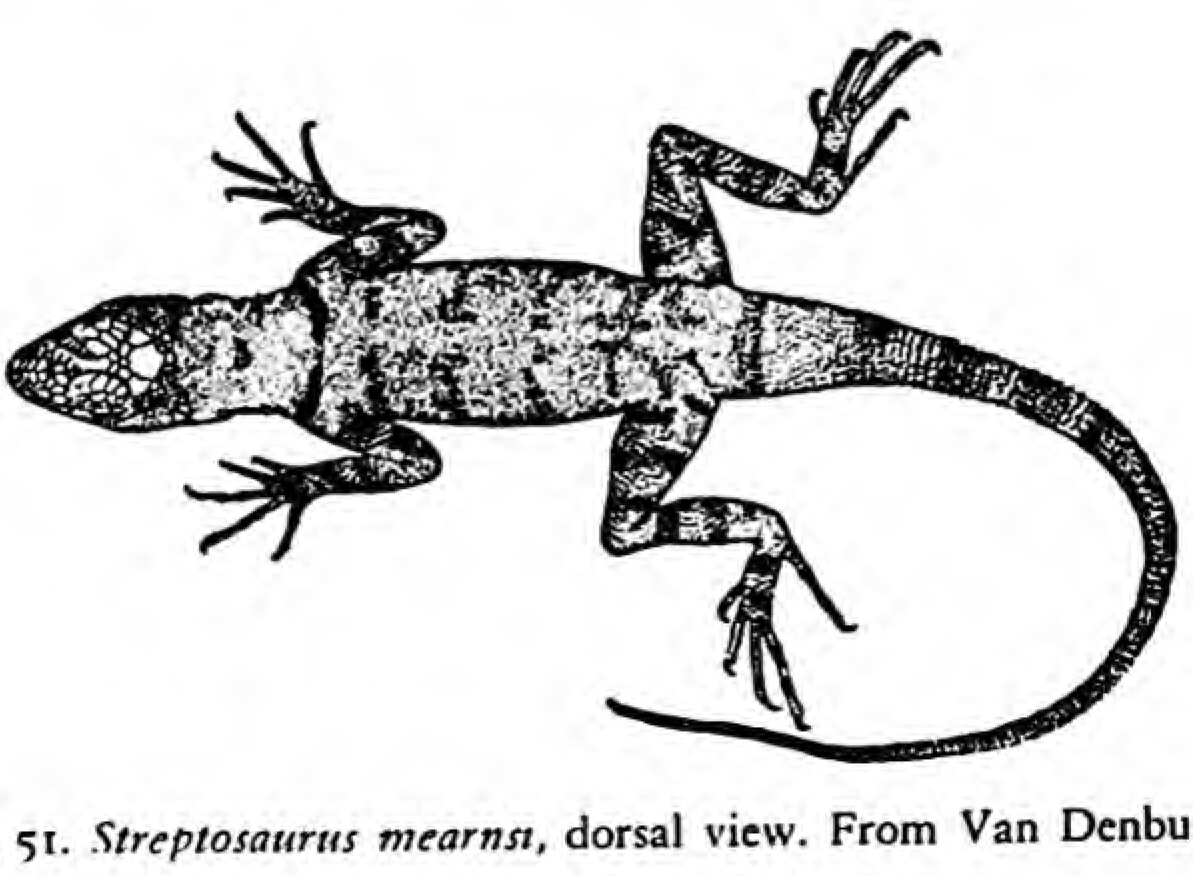


FIG. 51. *Streptosaurus mearnsi,* dorsal view. From Van Denburgh.

11. A longitudinal dorsolateral line or dermal fold, usually with some enlarged scales on it (Fig. 52); usually a second, lateral fold; no small, rounded, blue blotch behind axilla; frontal divided or not (Fig. 54) .... *Urosaurus* (p. 256)
    No longitudinal dorsolateral dermal fold (Fig. 53); often a small, rounded, dark blue blotch behind axilla; frontal always divided transversely (Fig. 55) .... *Uta* (p. 276)

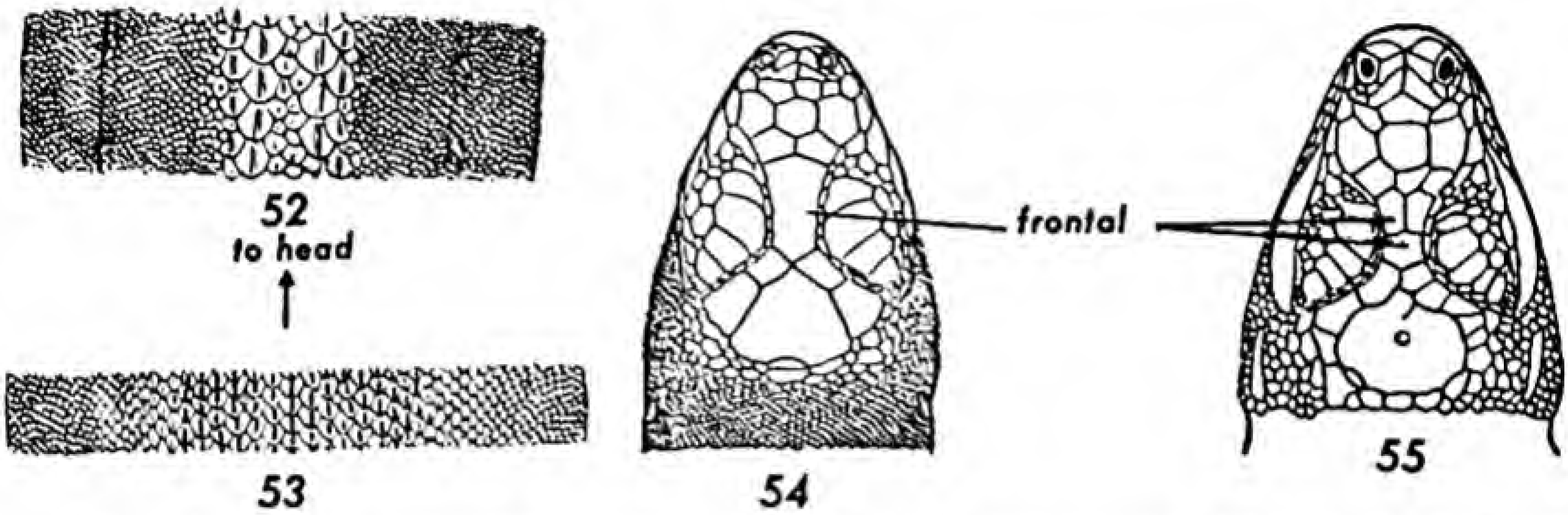


FIG. 52. *Urosaurus ornatus symmetricus*, strip of scales around middle of body. From Van Denburgh.
FIG. 53. *Uta stansburiana*, strip of scales around middle of body. From Van Denburgh.
FIG. 54. *Urosaurus microscutatus*, top of head. From Cope, after Van Denburgh.
FIG. 55. *Urosaurus ornatus symmetricus*, top of head. From Cope.

12. Two scales bordering mental posteriorly (Fig. 56), between infralabials; head very broad, neck narrow .... *Crotaphytus* (p. 166)
    Three or more scales bordering mental posteriorly (Fig. 57), between infralabials; head elongate, neck not so sharply defined .... *Gambelia* (p. 158)

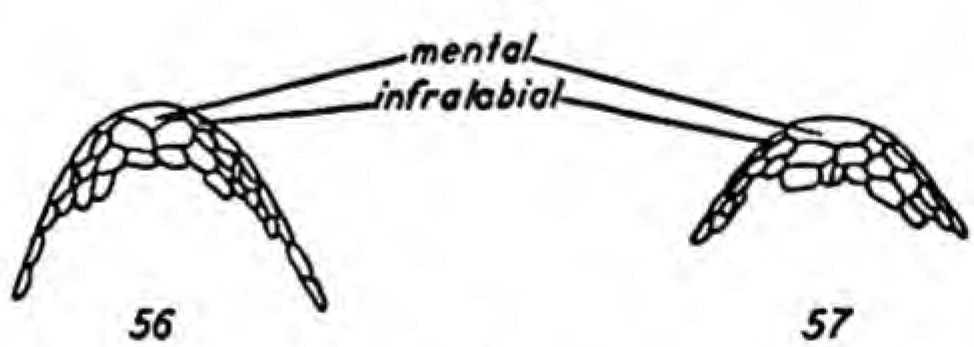


FIG. 56. *Crotaphytus collaris baileyi*, ventral view of chin. From Cope.
FIG. 57. *Gambelia w. wislizenii*, ventral view of chin. From Cope.

13. A median dorsal row of enlarged scales; no femoral pores; nasal in contact with rostral .... *Leiocephalus* (p. 319)
    Middorsal row of scales not larger than paravertebral scales; femoral pores present; nasal separated from rostral .... *Sceloporus* (p. 179)

The wide variety of form and other characteristics of the genera of the iguanids makes very desirable a segregation of the related genera. Mittleman (*gen. lit.*) has recently initiated such a segregation of North American genera. For the most part his ideas are expressed in the arrangement adopted here, and are portrayed in the accompanying diagram (Fig. 58), modified from Mittleman. Six sections of the family normally occur in North America, and another is represented by a form imported from the Atlantic islands.

This arrangement of genera into sections is not a final and positive one. It is too new a field of endeavor to have reached stability as yet. The so-called

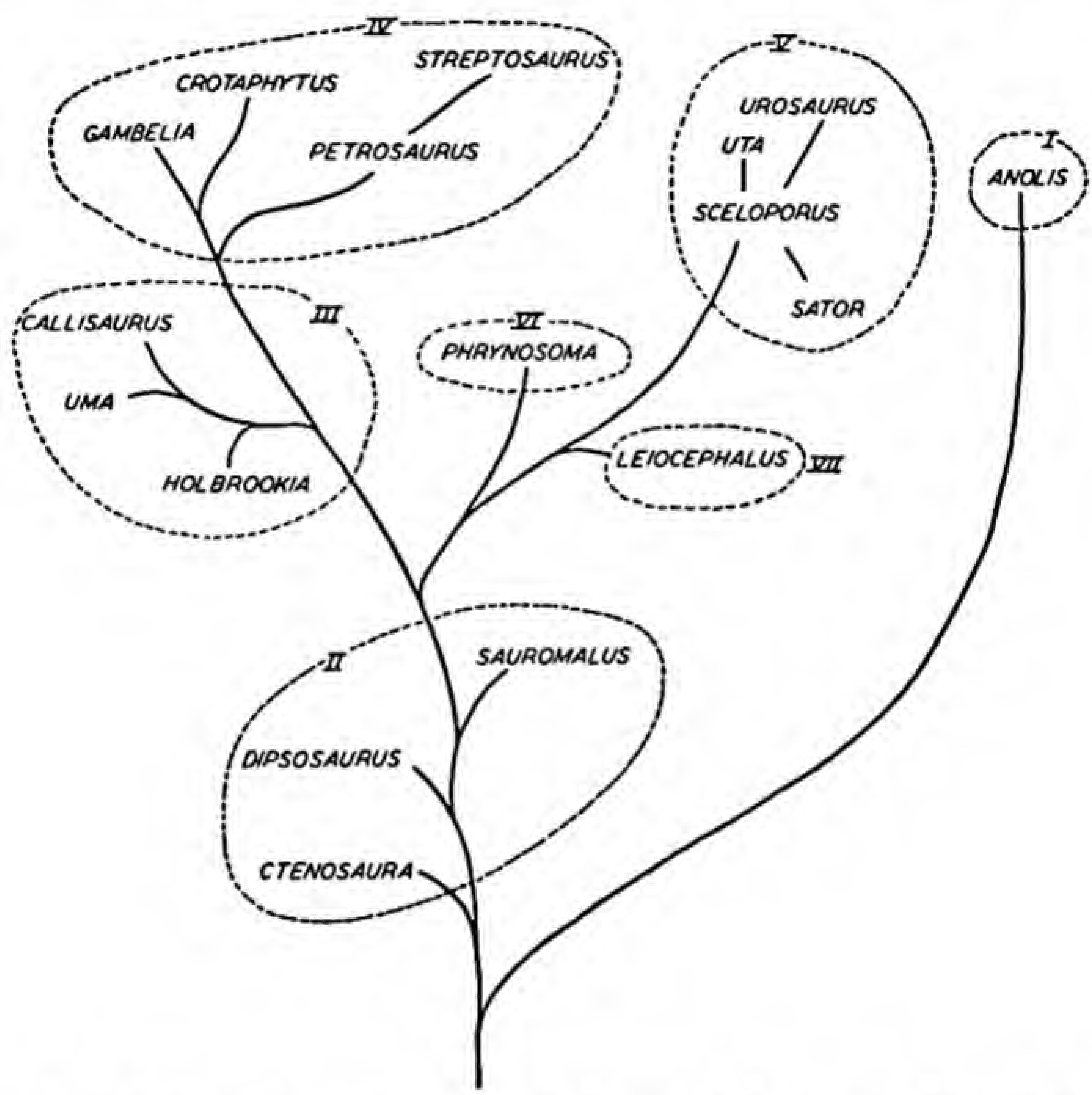


Fig. 58. Grouping and possible phylogeny of the genera of iguanids occurring in the United States.

"rock-lizard" section is the source of most divergence of opinion, which centers upon the validity of *Gambelia* as a distinct genus, and of *Streptosaurus* and *Petrosaurus* as genera distinct from *Uta* and *Urosaurus*. The last four until recently have been included in a single genus, *Uta*, and only on splitting it into more compact groups does the question of the proper allocation of the several groups (genera) into one or two generic sections become acute. At present Mittleman's suggested arrangement appears very attractive and plausible.

The Leaf-toed Section

This is a puzzling section of some seven genera, all of small species. Most of them have the toes and fingers expanded in a characteristic manner, and most lack femoral pores. This section is considered by anatomists as one completely apart from the other sections of the family; it is generally treated as a separate subfamily, Anolinae, while the other sections belong to the subfamily Iguaninae. Only one genus of this section occurs in the United States; the others occur in Central and South America.

The Anoles

Genus *ANOLIS* Daudin

Without question the largest, most complex, and most widely distributed genus of lizards in this hemisphere is *Anolis*. In the neighborhood of three hundred species and subspecies are known—about three times as many as in the next largest genus of the hemisphere (*Sceloporus*). All the species are of small or medium size, however. The two that occur within the boundaries of the United States are small. The large species reach a maximum body length of about 6 inches, and the tail is proportionately long. In all species the body form is much the same—once we learn to recognize one anole as belonging to that genus, we can recognize as an anole almost any other member of the genus.

Practically all species are arboreal, although some are seen frequently on the ground. In certain areas human habitations are frequented. The climbing proclivities are due to the peculiar pads on the feet, the chief characteristic of the genus. The next to the last phalanx of the fingers and toes has the transverse lamellae on the underside expanded to form an elongate pad (see Fig. 35) that enables the lizard to hang onto relatively smooth or vertical surfaces. The last phalanx is normal in shape, elongate, and terminates with a claw.

A second peculiar characteristic of the anoles—one not shared by any other lizards, at least to such an extent—is that of a prominent throat fan in males. The males of all species of the genus have such a fan, which is flared by the downward and forward movement of a flexible rod of cartilage (a portion of the hyobranchial apparatus), just inside the skin, that swings from its point of attachment near the middle of the fore part of the throat. As this rod swings downward, the loose throat skin, which sometimes extends back to the middle of the belly, is pulled with it and stretched in a thin flap or fan as far forward as the snout. Of course, to show the full extent of the fan the lizard has to hold its head and fore part of the body up from their support, and to do this it straightens the forelegs nearly their full length. As the fan flares the

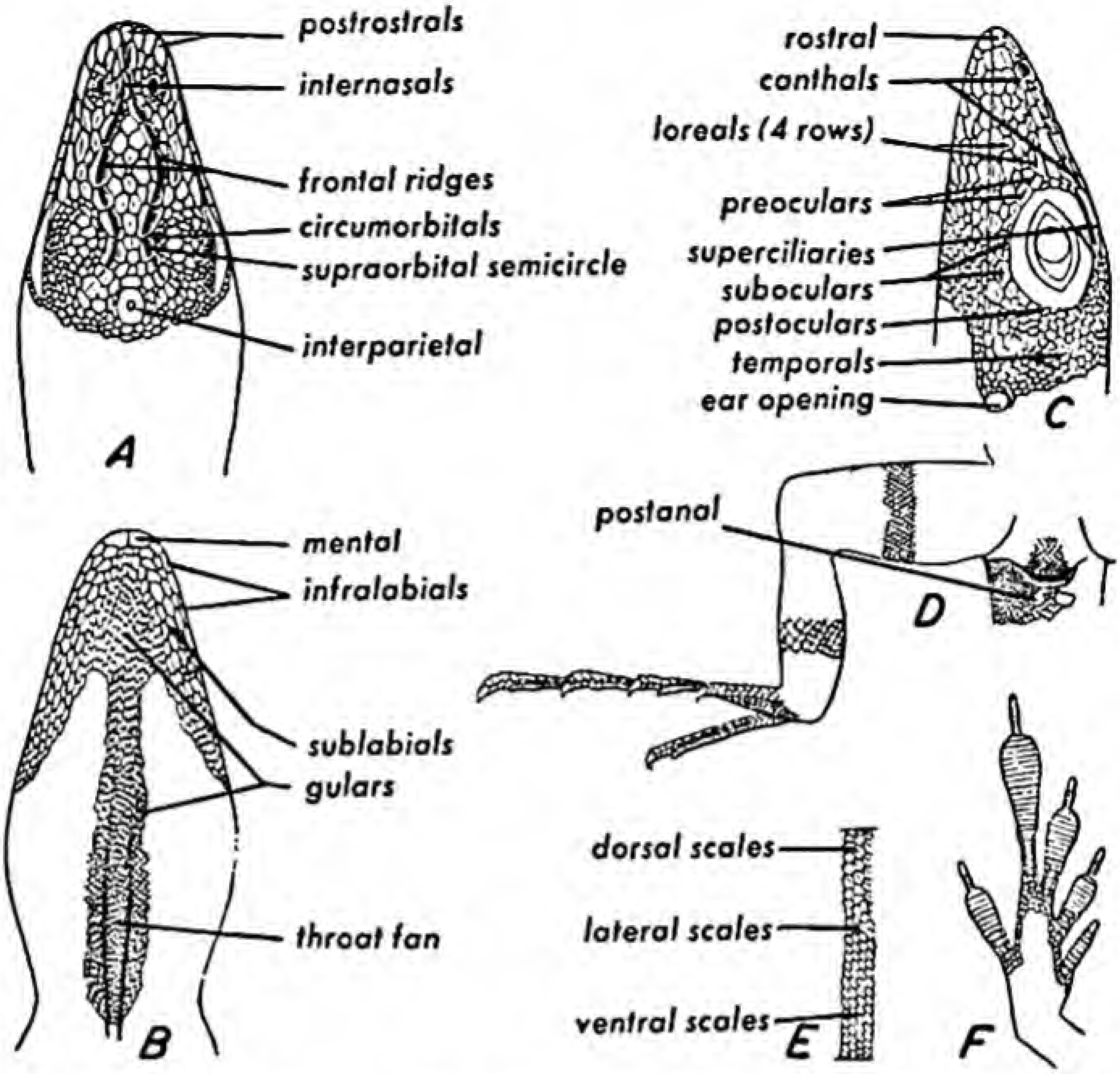


FIG. 59. Typical scutellation in *Anolis*, from *A. carolinensis*, locality unknown. A, top of head; B, underside of head, C, side of head; D, ventral view of right hind leg and anal region; E, section of body in lateral view; F, ventral view of hind foot. From Cope.

color of the skin between the widely spaced rows of small scales is brightly displayed. Frequently these colors are very bright, usually yellow, orange, or red. Some species have a yellow dewlap (fan) with a blue central spot. In others the fan is of a dull color. For a description of the throat-fan mechanism see Von Geldern (1919, *lit. cit.*). Some details of the scutellation of a typical species are shown in Fig. 59.

The numbers of some species are very closely correlated with the season of the year, even in the tropics. Some species are found only in the dry season, others only in the rainy season. Where they manage to hide at other times is not clear.

All species lay eggs. Some lay the eggs in clusters of two or four in large, parasitic air plants (bromelias). Others may lay their eggs under bark or on the ground.

These little creatures are one of the most interesting features of the American tropics and of southeastern United States. Their active clambering about trees and fences, their flashing fans and dashing combats, their breath-taking falls and indignant recoveries form an endless and constantly amusing repertoire which one can watch with interest indefinitely.

KEY TO SPECIES OF *ANOLIS*

1. Tail laterally compressed, with a dorsal ridge; ventral body scales much larger than dorsals .... *stejnegeri* (p. 99)
   Tail round, without a dorsal ridge; ventral body scales not, or slightly, larger than dorsals (Fig. 59E) .... *carolinensis* (p. 95)

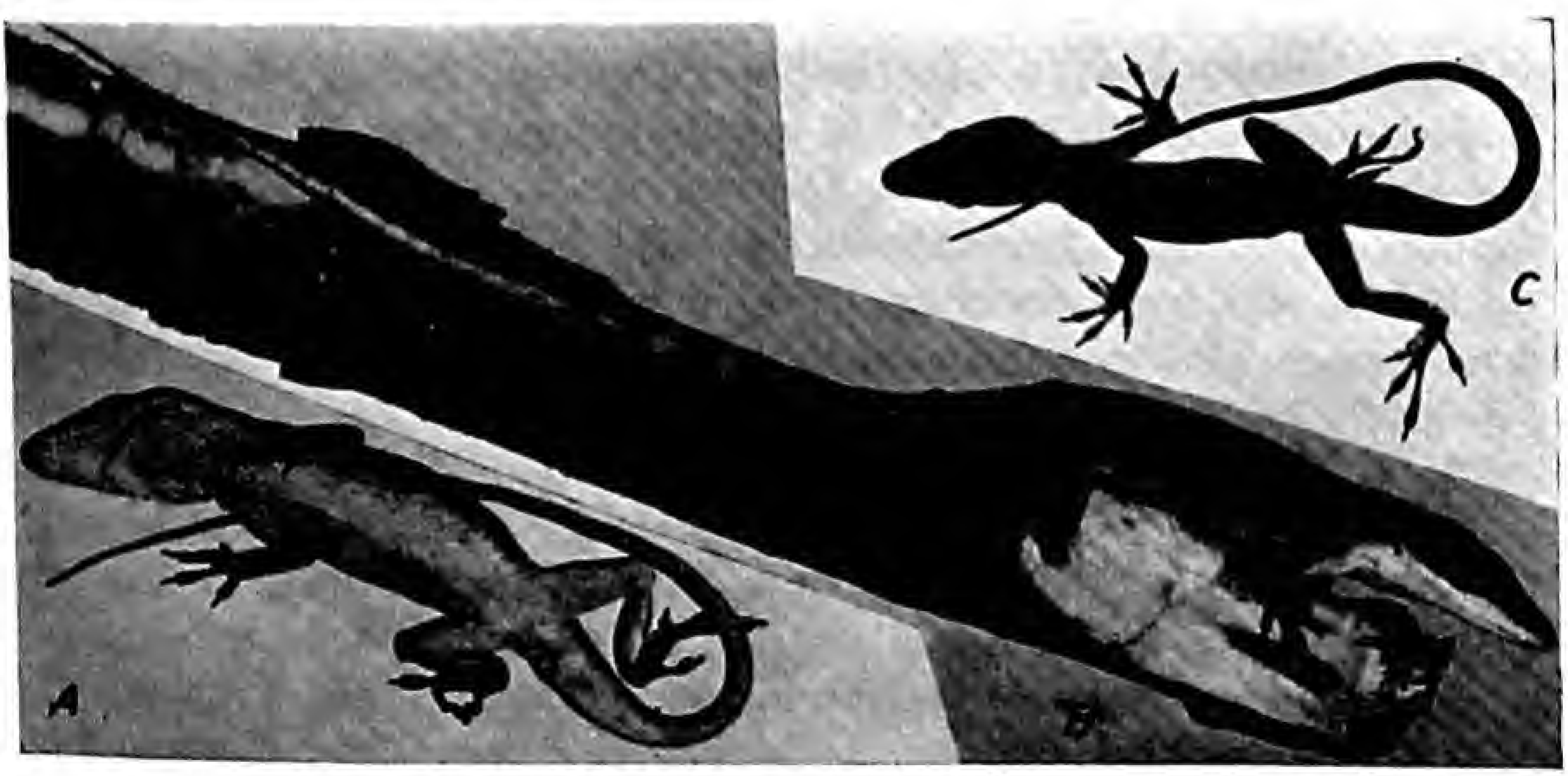
Carolina Anole *Anolis carolinensis* Voigt

(Fig. 59, Pl. 11)

Range. North Carolina through Florida and westward through the Gulf region to the Rio Grande, mainly in the coastal plain. Type locality—Carolina. (Map 2, p. 485.)

Size. Large specimens reach a size of about 61 mm. (2⅜ in.) snout to vent. The tail is much longer, about twice the length of the head and body.

Color. The color of lizards capable of changing their color as readily as these is difficult to describe. They may be a uniform light brown above and flecked with brown below, or pure, pale green above and white below. Almost all imaginable intermediates between these two extremes can be assumed by the lizards at will. The back may be mottled with brown and green, or show short, irregular, dark stripes. Dark specimens usually show several short,



Pl. 11. *Anolis carolinensis*. A, Auburn, Alabama; female. B, Thomson, Georgia; male. Gloyd photograph. C, Auburn, Alabama; male.

longitudinal, dark streaks on the sides of the throat, fine white flecks on the sides of the body, and a dim reticulation or spotting with darker brown on the sides of the abdomen. Both green and brown specimens have a white or cream stripe along the sides of the head below the eye; in dark specimens it extends to the shoulders more or less through the middle of the ear.

The dewlap in males is colored a brilliant red. The females lack the dewlap but sometimes show faint indications of it in the middle of the throat.

According to Kleinholz, whose notes are based upon live specimens,

> in its color play *Anolis* ranges from dark brown to bright green, intermediate shades including light brown, yellow, yellowish green and emerald green.
>
> Individual lizards are not uniformly colored but show considerable variation in certain regions of the body. A dewlap, or throat fan, is present, being most highly developed in males. When erected in combat or in courtship it is brilliant red, due, in part, to granules of pigment in the skin of that region. In some animals a mid-dorsal longitudinal [light or white] band is present, extending from the cervical region for varying distances toward or even along the tail; in many lizards it is completely absent.
>
> When an animal is in the dark condition, a regular darker pattern is discernible against the brown color of the rest of the body; such markings vary among specimens but are constant in form for a particular individual. The darker areas consist of groups of from two to a score or more of scales scattered over the dorsal and lateral aspects of the body and appendages. In addition to this body pattern all lizards have a darker quadrangular patch immediately posterior to each orbit. In some individuals a similar area is located over each scapula. . . .
>
> In the light state the dorsal and lateral surfaces of the body are green. The ventral surface ranges from cream colour to brownish white in appearance and is frequently peppered over with black spots.

Scalation. See Fig. 59 (p. 94). The head is long, flattened, and rather wedge-shaped, covered above with small, heavily keeled scales. The dorsal scales are very small, with blunt keels. The ventral scales are slightly larger than the dorsal scales, and a little more strongly keeled. The fingers and toes, except the first on each hand, are curiously expanded near their tips; the expanded parts are provided with numerous fine lamellae; beyond the expanded part extends the last joint, with the claw, of each digit.

The male has a loose, longitudinal fold in the middle of the throat, supported internally by a rod of cartilage. This supporting rod can be lifted away (downward) from the surface of the body by swinging it from its attached, anterior end; thus the loose skin is pulled away from the body and flared so as to show the bright color of the skin between the scales. There are no femoral pores, but enlarged postanal scales are present. The tail is round in cross section.

Habitat. In much of the range of the species, anoles are one of the commonest and best-known lizards. They are found on trees, shrubs, vines, low vegetation, fences, and sometimes old wooden buildings. Shade, some sort of protection, and something on which they can climb limit their range of habitat. In relatively dry areas they choose moist habitats.

Habits. One of the most conspicuous and characteristic habits of the Caro-

lina anole is ready and rapid color change. These frequent color changes have earned the anole the name of "American chameleon," but it is not a true chameleon at all. Low temperatures induce a dark color, whether in shade or sun. At high temperatures the color is subject to control by other factors. Darkness generally is accompanied by the green color, which is also assumed during fighting and other times of excitement, and at death. Light received by the body causes "a dark brown chestnut phase (extreme expansion of the chromatophores)." In light an interplay of control by optic and skin receptors determines the color. The skin receptors cause complete expansion of the chromatophores, resulting in a dark brown chestnut phase, regardless of the proportion of green to other colors in the light. The eyes, however, inhibit the expansion of the chromatophores to an extent that increases with the amount of green in the light received; in pure green light they completely inhibit the expansion, so that the animal appears green; and as the proportion of green decreases, the animal becomes more brownish. The eye receptors dominate the skin receptors, but the eyes are sensitive (in this respect) only to green, while the skin is sensitive to green alone or to any combination of green and other colors. Thus, in the field, under "conditions where green leaves serve as a heavy green screen over the chameleons, they are green, regardless of background. The writer has watched green chameleons climb from under dense green foliage so that they were exposed directly to the sky light. These individuals then turned brown and were very conspicuous against the green background" (Wilson, 1939). Further discussion will be found in the introduction.

Like most other United States lizards, anoles are diurnal, beginning their movements when the temperature has risen in late morning. They are most active early in the day. They feed largely upon flies and no doubt serve a useful function in the control of mosquitoes. In the Florida celery fields they have been observed in numbers feeding on destructive caterpillars and moths.

On the other hand, they furnish food for numerous predators, including snakes and various birds. The males frequently fight among themselves, spreading the throat fan as a threatening gesture. A similar intimidation habit is to elevate the skin along the middle of the back and neck to form a high crest.

Eggs, usually 2 in number, are laid in June or July, and are buried a few inches below the surface in loose, slightly moist debris. The eggs measure about 6 x 11 mm. and are rather soft-shelled. They hatch in 6 to 7 weeks.

Carr states that

> this is the most arboreal Florida lizard; I have watched the males fighting among the limbs of sweet-gums fifty or sixty feet above the ground; in pursuing the females they often leap two feet or more from one limb to another. They take to water readily; if alarmed while on a bush over a pond, they sometimes jump into

the water and swim away. On the night of April 24, 1934, I counted eleven of them asleep on several water-oleander bushes in the middle of a little pond; all these individuals were pale silvery-white in color.

Mating takes place in north Florida in April and May; the eggs are laid in June and July in trash piles and in rather dry decaying wood. On June 17, 1934, in Key West, Pierce and I found twelve eggs (probably the complements of several individuals) in a rock pile. The eggs were laid singly throughout the pile; they all hatched within the ensuing week.

The "skin" is shed several times a year and is usually eaten.

It is not known how long these lizards live under natural conditions. In captivity they have been kept over three years.

Since the anole is the most common reptile "pet" or curio in the United States, some details of its proper care may be of interest. Although the lizards are normally short-lived, many die prematurely in captivity because of lack of attention.

In summer, anoles may have the run of a screened porch, where they prove useful in capturing and destroying flies, ants and other insects, but during the winter a cage should be provided. A box, preferably one at least 2 or 3 feet long, placed where it will receive plenty of sunlight may be used. The open face should be covered with a pane of glass, mosquito netting, or a fine-meshed wire screening. A small, shallow bowl containing a water hyacinth . . . or some other water plant should be placed inside the cage and a little water sprayed over its leaves at least once each day, as these lizards normally procure what water they require by lapping up with their thick tongues scattered droplets on leaves. A captive anole may soon die of thirst even with a pan of water in the cage. *Do not give sweetened water. An anole will soon die on a diet of sugar and water.*

Chameleons feed primarily on soft-bodied insects but are fond of spiders also. Captive chameleons may be fed on flies and meal worms or on insects caught in a net swept through rank vegetation. Under ordinary conditions, live meal worms will prove to be the most satisfactory diet, especially as they may be bred or purchased from dealers. Cockroaches have been found acceptable when other insects have been refused. Sowbugs, which are usually found in large numbers around greenhouses, may also be utilized, though they are not especially relished. If anoles are kept caged during the summer, a small piece of decaying fruit should be placed inside the inclosure to attract flies. Bluebottle flies are not satisfactory food, and continued feeding of these usually results in the death of the lizard (*Wildlife Research and Management Leaflet* BS-92).

Problems. A summary of the rather extensive literature on this species is much to be desired. The paucity of good, complete notes on the life history is astonishing. It is also not improbable that the species is composed of at least two geographic races.

References. Breder, 1922, pp. 45–46, egg-laying (*lit. cit.*); Carr, 1940, pp. 71–72, habitat, habits, breeding, in Florida (*Fla.*); Ellis, 1940, pp. 162–164, figs. 1–3,

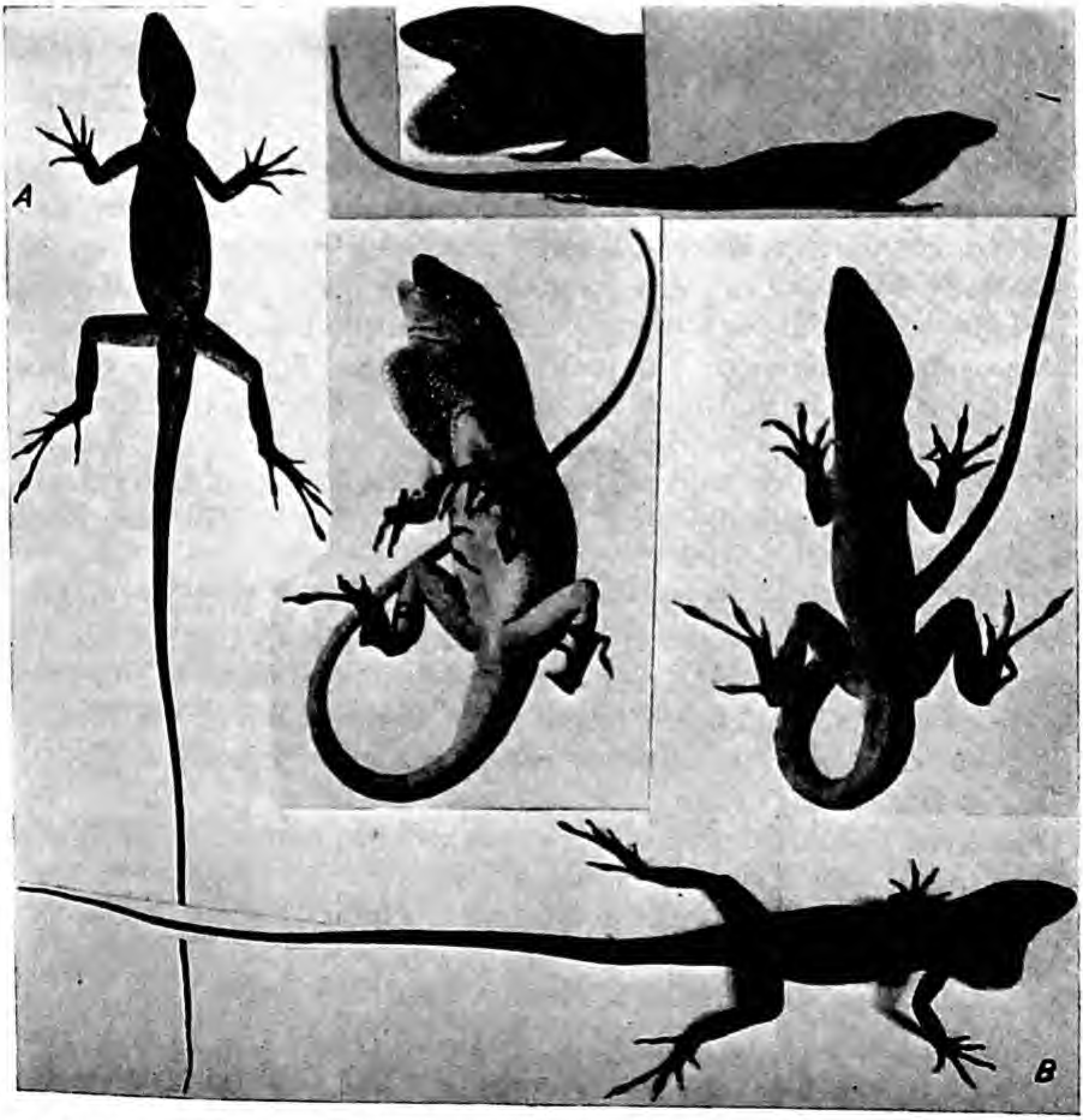
fighting and mating (*lit. cit.*); Evans, 1935, pp. 3-6, mating, community reactions (*lit. cit.*); Jones and Ressler, 1927, pp. 87-88, habitat in Tennessee (*Tenn.*); Kleinholtz, 1938, pp. 474-491 (*lit. cit.*); Wilson, 1939, pp. 190-192, reaction to green light (*lit. cit.*); *idem*, 1940, pp. 151-153, color reaction to temperature (*lit. cit.*).

Key Anole *Anolis stejnegeri* Barbour

(Fig. 35, p. 87; Pl. 12)

Range. Known only from Key West, Florida. Type locality—the same.

Size. A fully adult male measures 52 mm. (2$\frac{1}{16}$ in.) snout to vent, and the



Pl. 12. *Anolis stejnegeri.* Key West, Florida; male. A, B, U.S. Fish and Wildlife Service photographs.

tail 98 mm. (3⅞ in.); the tail may be a little more than twice the snout-vent length. (Map 38, p. 511.)

Color. A specimen long preserved is a uniform dark brown above, but in life it may be bright green. In a fresh specimen the throat is "faintly rayed with darker green; gular fan carmine at base, slightly darker, almost maroon anteriorly, scales showing as ashy grey dots, while anteriorly the border is broadly and conspicuously ivory white. Thus, with the fan at rest, a wide, white gular streak is to be observed, which must be very diagnostic in the field" (Barbour).

Scalation. Head scales with one or more longitudinal keels; supraoculars small, 9 to 11, the largest near the middle, separated from supraorbital semicircles by a series of small scales; supraorbital semicircles composed of large scales, in contact medially or separated by 2 rows of scales; interparietal a little larger than ear opening, separated from supraorbital semicircles by 2 or 3 rows of small scales; 4 or 5 rows of loreals, the scales in the lower row fairly large; mental divided, larger than rostral.

Ventral scales much larger than dorsal scales, all keeled; lateral scales very small, grading into the somewhat larger dorsal scales. Tail compressed, with a continuous dorsal ridge; lateral scales of tail smallest, only a little smaller than belly scales. No enlarged postanal scales in males. No femoral pores. Lamellae on penultimate phalanges of digits enlarged transversely.

Recognition Characters. The presence of enlarged digits, eyes with lids, and ventral scales much larger than dorsal scales identifies this species. From the Carolina anole, the only similar lizard of the United States, the key anole differs in having much larger ventral scales and the lateral caudal scales considerably smaller than the dorsal and ventral caudals, as well as in other characters.

Habits and Habitat. "Trees, shrubs, and the walls of buildings in Key West; particularly the trunks of coco-palms in the Navy Yard. . . . Locally common; more numerous in the Navy Yard than *carolinensis*. . . . In view of the great abundance of these lizards in the northwest end of Key West, it seems rather strange that they have not become more generally distributed throughout the island" (Carr).

Problems. The relationship of this species with the common *Anolis sagrei* of the coastal areas about the Caribbean Sea is very close; they can be separated only on the basis of the dewlap color. Further investigation of the variation in this character in *sagrei* and *stejnegeri* will be of considerable interest, as it will reflect upon the validity of the latter species.

References. Barbour, 1931, pp. 87–89, description (*Fla.*); Burt, 1936, pp. 262, 298, 304, figs. 25 of fourth toe, 31 of tail scales (*gen. lit.*); Carr, 1940, p. 72, habits and habitat (*Fla.*).

The Herbivore Section

This includes the large, primitive iguanids. It includes the the genus *Iguana*, from which the family derives its name, a large, 6-foot, green lizard of the tropics. Two other large genera are in the Galápagos Islands. *Dipsosaurus* and *Sauromalus* are the only United States genera. Although *Ctenosaura* is sometimes listed in the United States fauna, I am fairly confident it does not occur within the boundaries of the country; authentic records are from localities no nearer than 150 miles south of the border in Sonora.

It is a curious fact that all these genera, and the few others that belong to the section (West Indies), are herbivorous. An herbivorous habit is not, because of this, to be considered a valid reason, by itself, for allocation of any genus in this section; more important are numerous morphological characters. Among them are the short, thick head, small scales, and large size.

The False Iguanas

Genus *CTENOSAURA* Wiegmann

The lizards of this genus are among the largest of the Americas. North of South America they are exceeded in size only by the true iguanas (genus *Iguana*), which reach an extreme length, including a very long tail, of about 6 feet. The ctenosauras are frequently called iguanas, but they are much different from the true iguanas, and so are here termed false iguanas. The largest specimens reach a length of some 4 feet. Old males, which are unbelievably wary, greatly exceed the size of specimens ordinarily seen and caught. Very few of these giants ever reach collections. Some species are diminutive, not reaching more than 12 or 14 inches in total length. These small species also have peculiarly modified tails, and form a distinct group which probably should be considered a distinct genus. Some details of the scutellation of a typical species are shown in Fig. 60.

Some ten or eleven species are now recognized in the genus, which extends from Honduras northward almost into the United States. As yet there is no definite record of its occurrence there, but because of its general interest and a vague, but possibly correct, record from the vicinity of Nogales, it is included here. Collectors should make a special search for this species in that vicinity.

All species of the genus are herbivorous and diurnal.

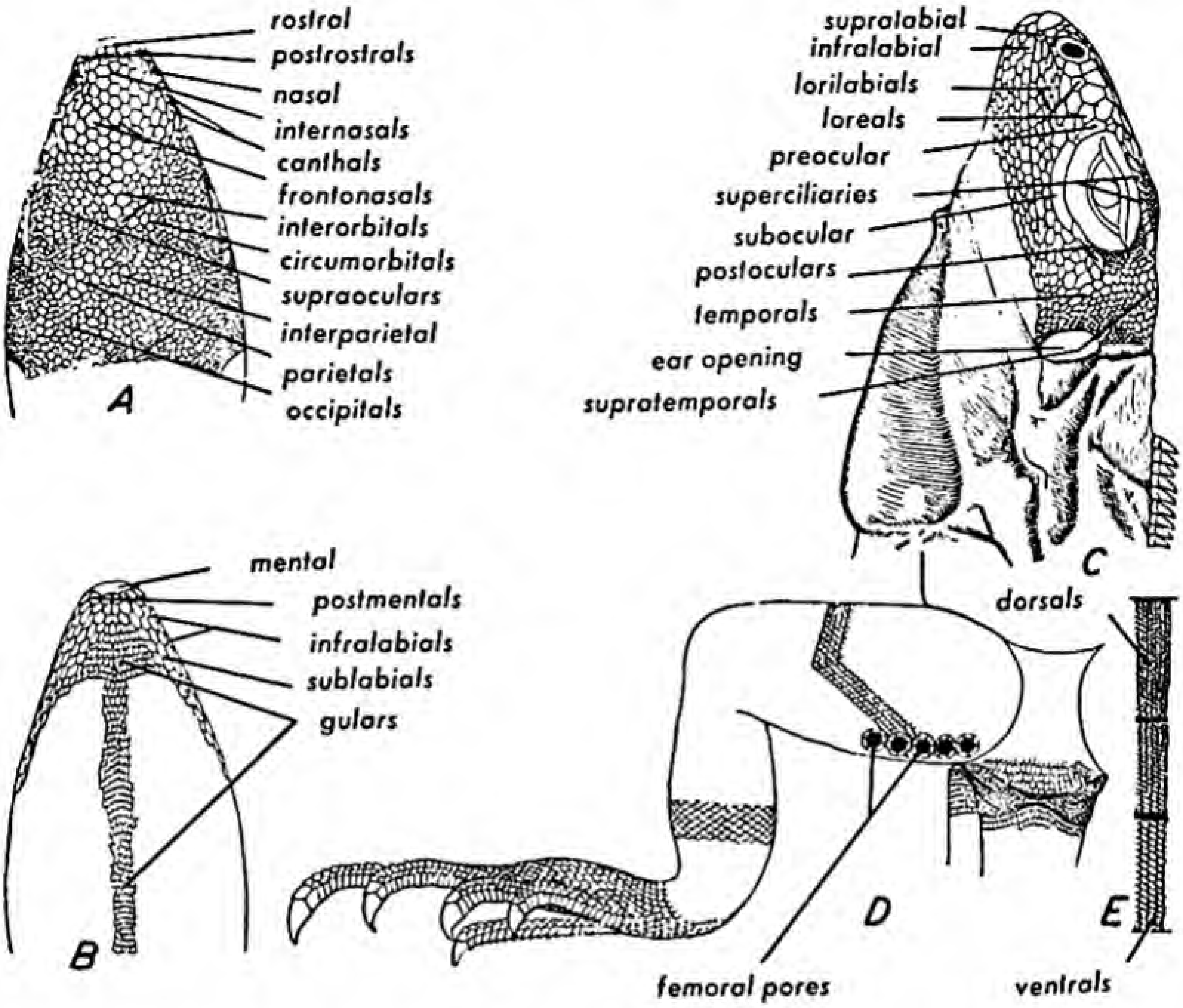


FIG. 60. Typical scutellation in *Ctenosaura*, from *C. hemilopha*, La Paz, Baja California. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in lateral view. From Cope.

Northern False Iguana *Ctenosaura hemilopha* (Cope)

(Fig. 60; Pl. 13)

Range. Known at present only from the southern two thirds of Baja California, the central and western parts of the state of Sonora, and several islands in the Gulf of California, all in Mexico. It has been recorded from Nogales, Arizona, but the record is held in some doubt. It has been seen not far from the border, and very possibly actually does occur within the boundary of the United States. An accurate record for this country, however, is not yet known. Type locality—Cape St. Lucas, Baja California. (Map 5, p. 487.)

Size. Much larger than any species now definitely known from the United States, except the Gila monster, having a maximum snout-vent measurement of about 295 mm. (11⅝ in.). The tail is about 1⅓ to 1⅔ times the length of the head and body. The body is stout, but not fat; the head is angular and thick, and tapers toward the snout. The limbs are strong, the hind legs rather markedly larger than the forelegs, about ⅔ the snout-vent length in males, a little less in females.

Color. The general ground color is gray to straw yellow. The back is marked with nine crossbands of varying size and distinctness; the anterior is very small and very black; the second is broader, fading into seal brown laterally above the arms, but very dark medially; the third is broader and not so dark medially, but reticulated with a lighter color; the remainder are reticulated

Pl. 13. *Ctenosaura hemilopha.* Ten miles northwest of Guaymas, Sonora; male. Smith photograph.

with black and seal brown, and separated by narrow light bands most distinct medially. The sides of the body are rather uniformly reticulated and spotted with seal brown. The forelegs are black, with several narrow, light crossbands. The hind legs are marked like the sides of the body, but the feet are darker; there are several broad, more or less irregular, light crossbands. The tail has several broad, dark bands, the most prominent of which are five near the tip; these are very dark brown or black. The light areas on the tail are straw yellow clouded with olive. The chin, gular region, and chest are blackish brown, the belly gray.

As in other false iguanas, the very young individuals (up to 76 mm., or 3 in., snout to vent) are bright green above (except the tail which has broad rings of dark olive separated by narrow ones of broccoli brown), the belly lighter. As they increase in size, the green fades and the dark crossbars become evident.

Scalation. See Fig. 60. The body is covered with small, flat, not sharply pointed scales, above and below; those on the belly are the largest, and those on the sides smallest. The head is covered by fairly uniform, small, flat scales, largest on the snout; the labial scales are enlarged, low. The supraoculars and superciliaries are not enlarged or modified. The ear is large, the tympanum scarcely depressed, and there are no enlarged or free scales around it. One of the chief features is a longitudinal series of enlarged scales along the middle

of the back, beginning near the occiput and disappearing near the rump. In males these scales are very strongly produced and form a crest nearly half an inch high at the highest point; in females the crest is very low. The scales on the tail are much enlarged, especially those of every second or third row; these are very strong and bear a sharp, elevated keel that looks, and tears, like a blunt, fixed claw. The ventral scales of the tail are uniform and low, although keeled. There are 4 to 8 femoral pores on each side. Males lack enlarged postanal scales.

Recognition Characters. The very spinose tail and median series of enlarged scales on the back identify this lizard.

Habitat. Taylor found his specimens in Sonora in rock cliffs. In Baja California they occur in areas where rock boulders furnish protection and vantage points, or, lacking boulders, in trees. Mexican specimens of other related species are known to inhabit either rocks or trees.

Habits. The false iguanas are good climbers, scrambling noisily but with speed on rock cliffs, boulders, or trees. The claws are long, strong, and sharp, and serve well as an aid in climbing. These animals are exceedingly wary, especially so since they are hunted for food in many parts of their range. They hide in crevices or hollows upon the slightest provocation, and can usually be extracted only with great effort. When captured uninjured, it is necessary not only to hold the head to keep the powerful jaws from the hands or body, but also to hold the body straight to prevent the claws of the hind legs from scratching viciously, as they can do; moreover, the tail has to be cornered under an arm to keep it from being slashed about with very painful results. In truth, this lizard is the roughest species to handle of all those of North or Central America; the Gila monster, while more dangerous because of its poison, is no match for the false iguana in viciousness, activity, and spiny defenses. The false iguana is a regal sight, its big head and the fore part of the body projecting above the line of protecting boulders. Even these large lizards bob their heads, like their smaller relatives.

The food consists entirely of vegetation, such as leaves, twigs, blossoms, and fruits. It has been suggested, without foundation, I believe, that they eat crabs.

The life history is unknown.

Problems. The life history of this large species is well worth a careful study. In fact, none of the ten or eleven species of this genus have been adequately investigated.

Still another inviting problem is the northern extent of its distribution on the mainland. It should be looked for in the rocky, barren mountains along the border near Nogales.

A final problem concerns the identity of the mainland (Sonora and United States) specimens. It has been suggested by Smith that they are not identical with Baja California specimens.

References. Bailey, 1928, pp. 17–22, pl. 5 (*lit. cit.*); Smith, 1935, pp. 140–142, pl. 23, fig. 1 (*lit. cit.*); Van Denburgh, 1922, pp. 66–71 (*gen lit.*).

The Crested Lizards

Genus *DIPSOSAURUS* Hallowell

This is a small genus of some five recognized species and subspecies, all very similar, occurring in Baja California and adjacent islands, northwestern Mexico (Sonora), and southwestern United States. Its members are easily recognized by the row of enlarged scales down the middle of the back. The only other genus in North America that has a similar row of enlarged scales is *Ctenosaura,* a genus of large iguanas that nearly reaches the southern border of Arizona. There is no definite record of the occurrence of that genus in this country, however, and I doubt that it will ever be found occurring here naturally. *Ctenosaura* may easily be distinguished from *Dipsosaurus* by its having every second or third ring, or whorl, of scales on the tail modified with enlarged, very spiny, tough scales. These two genera, although very dissimilar in size and habits, are rather closely related and belong in the same subfamily and section. Both are vegetarians and egg-laying. Some details of the scutellation of a typical species are shown in Fig. 61.

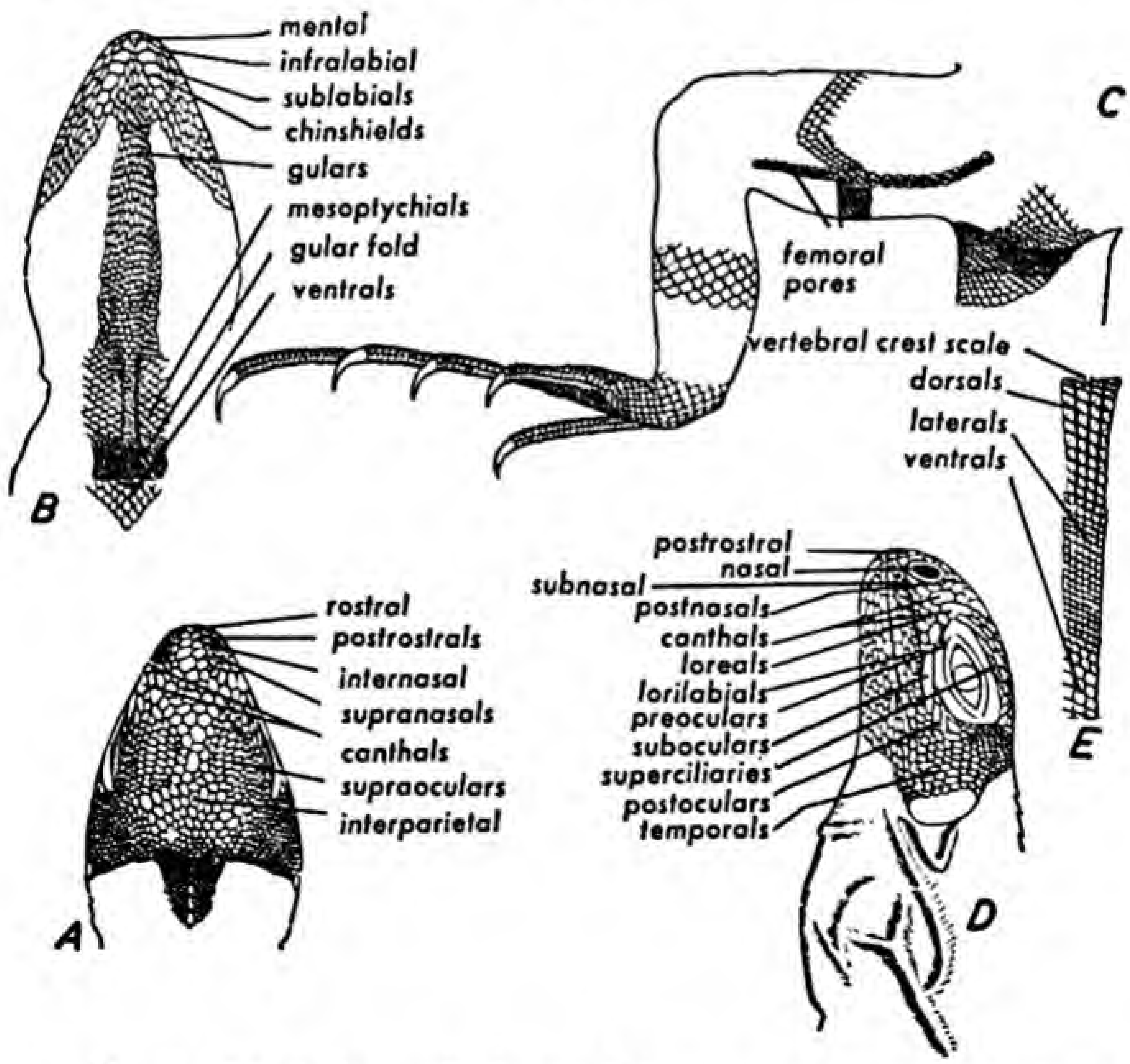


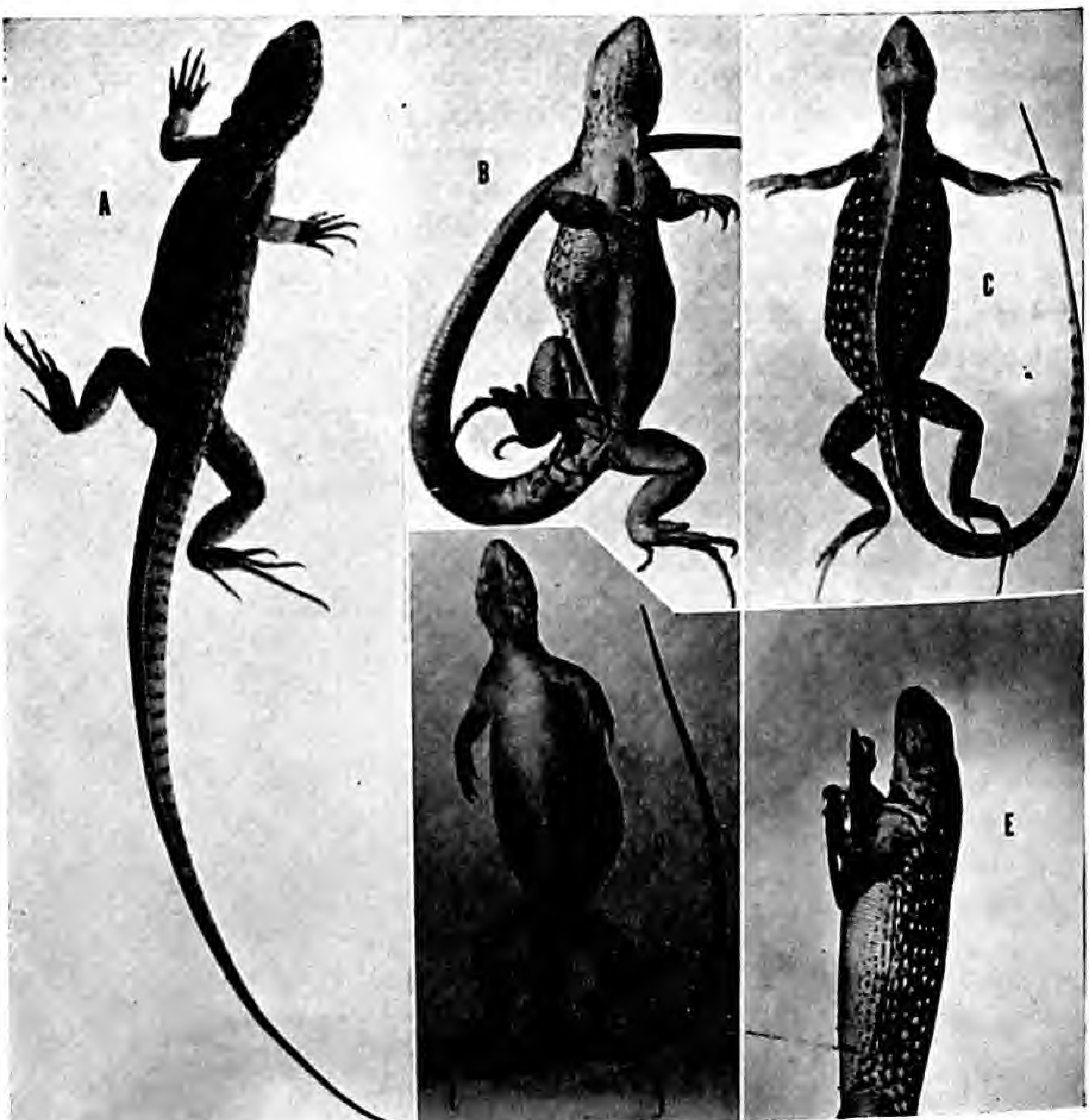
FIG. 61. Typical scutellation in *Dipsosaurus,* from *D. d. dorsalis,* Yuma, Arizona. A, top of head; B, underside of head; C, ventral view of right hind leg and anal region; D, side of head; E, section of body in lateral view. From Cope.

Northern Crested Lizard *Dipsosaurus dorsalis dorsalis* (Baird and Girard)

(Fig. 46, p. 89; Fig. 61; Pl. 14)

Range. Colorado and Mojave deserts in California, southern Nevada, and western Arizona; northwestern Sonora, the northern half of Baja California, and adjacent Gulf islands in Mexico. Type locality—Colorado Desert, California. (Map 2, p. 485.)

Size. These are large, fairly stout lizards with strong legs, a stout, long tail, and a rather small, blunt head. The snout-to-vent length reaches 133 mm. (5¼ in.), and the tail is usually a little less than twice as long as the body.



Pl. 14. *Dipsosaurus dorsalis dorsalis.* A, Indio, Riverside County, California; U.S. Fish and Wildlife Service photograph. B, E, Palm Canyon, California; male. C, D, 3 miles south of Gila Bend, Arizona; female.

Color. The general ground color is grayish brown; the back is reticulated with reddish brown, becoming slate toward the middle. These reticulations tend to form longitudinal lines toward the sides of the body; posteriorly the reticulation is coarse, but anteriorly it becomes somewhat finer, disappearing entirely on the sides of the neck; on the shoulders and neck the reticulation is reduced simply to dark borders surrounding small, rounded, white spots. Hind legs with vague dark areas, more evident near insertion. Tail with rings of small, rounded dots, not evident below. Ventral surfaces white or cream, with no dark markings except dim reticulations on the throat. The lips may be feebly barred. In life the dark reticulations on the back may be orange in color, and males have a large reddish-orange patch on either side of the tail. These colors fade in preservative.

Scalation. See Fig. 61. Head scales nearly uniform, all very small, those in median areas largest. Dorsal body scales very small, keeled. A median series of somewhat raised, strongly keeled, somewhat enlarged scales extending from near the head far upon the tail; this series of raised scales gives the lizard the name of "crested" lizard. Scales on tail a little larger than on body, all about equal in size, arranged in rings, keeled but not sharply spined. Ventral scales small, smooth. Femoral pores 18 to 26, average 22. Ear large, oval. Males lack enlarged postanal scales.

Recognition Characters. The series of enlarged scales down the middle of the back identifies this species and separates the United States race from all other lizard species of the country. Characteristic also is the peculiar pattern, the relatively large size, and the relatively small, blunt head. The head strongly resembles that of the most primitive, large iguanas like *Iguana, Ctenosaura Conolophus,* etc.

Habitat. These lizards live on the flat desert where they are frequently seen in the scanty shade of small bushes. They are exceedingly wary and dash away before the observer gets within 40 or 50 feet of them. They can best be hunted from a car, from which they do not run as readily as from human beings. In any case they usually must be shot. When not foraging, they live in small mammal burrows near the bases of bushes or cacti.

Habits. "When wounded they puff themselves up till their sides become taut, and may then be pulled from a small hole only with difficulty. With curiosity aroused they prop themselves high on their fore limbs, attentively viewing the passer-by and seldom showing-off with up-and-down movements of the body" (Camp). "On cloudy days, even though the temperature remains above 100° F., they may seldom be seen and appear sluggish, sometimes allowing one to approach to within a few feet of them before running" (Cowles). At temperatures of about 55° to 60° C. (131° to 140° F.) when the body temperatures are about 44.2° C. to 53° C. (112° to 127° F.), they die.

The food consists almost entirely of plant matter, including alfalfa leaves, or the leaves, flowers, and fruit of low bushes. This herbivorous habit is of

considerable interest and adds still further evidence for the relation of these lizards to the large primitive iguanas, which also are herbivorous.

It has been suggested that these lizards mate in August, when they have been seen in pairs and "seemed to be breeding. Observations seemed to show that a given pair occupied the same territory and rarely traveled far from it" (Cowles).

Hibernation begins in late October, when the animals burrow a few inches to 2 feet under the surface of the soil. The adults burrow to greater depths than the young.

Problems. Almost nothing is known of the breeding habits and life history of this species.

References. Atsatt, 1939, pp. 245–246, color changes (*lit. cit.*); Camp, 1916, p. 515 (*Calif.*); Cowles, 1941, pp. 128–129 (*lit. cit.*); Van Denburgh, 1922, pp. 73–78, pl. 2, general (*gen. lit.*).

The Chuckwallas

Genus *SAUROMALUS* Duméril

Few lizards of the Southwest are more fabled than those of this genus. This is no doubt due to their rather large size, their secretivity and abundance that together make them a game animal, and finally to their edibility.

There are some seven species [1] now recognized in this rather homogeneous genus. They are confined to Baja California and adjacent islands, northwestern Mexico (Sonora), and southwestern United States. They belong in the same general group as *Dipsosaurus* and *Ctenosaura,* and like them are herbivorous and egg-laying. Some details of the scutellation of a typical species are shown in Fig. 62.

[1] A revision of this genus entitled "The Chuckwallas, genus Sauromalus," by Charles E. Shaw, was published on August 31, 1945, in the *Transactions of the San Diego Society of Natural History,* vol. 10, no. 15, pp. 269–306, text fig. 1, map. Nine species and subspecies are treated; of these two occur in the United States. These two are distinguished as follows:

1. Scales finer and less spinose, especially on the tail; scales around middle of upper arm 50–61, av. 54.5; deserts of southeastern California, southern Nevada, southern Utah, northern Baja California, and Arizona north of the line Canyon Lake–Casa Grande–Yuma . . . . . . *obesus obesus* (Baird) (Great Basin Chuckwalla)

Scales larger and less spinose; scales around middle of upper arm 39–49, av. 44; Arizona south of the line Canyon Lake–Casa Grande–Yuma . . . . *obesus tumidus* Shaw (Gila Chuckwalla)

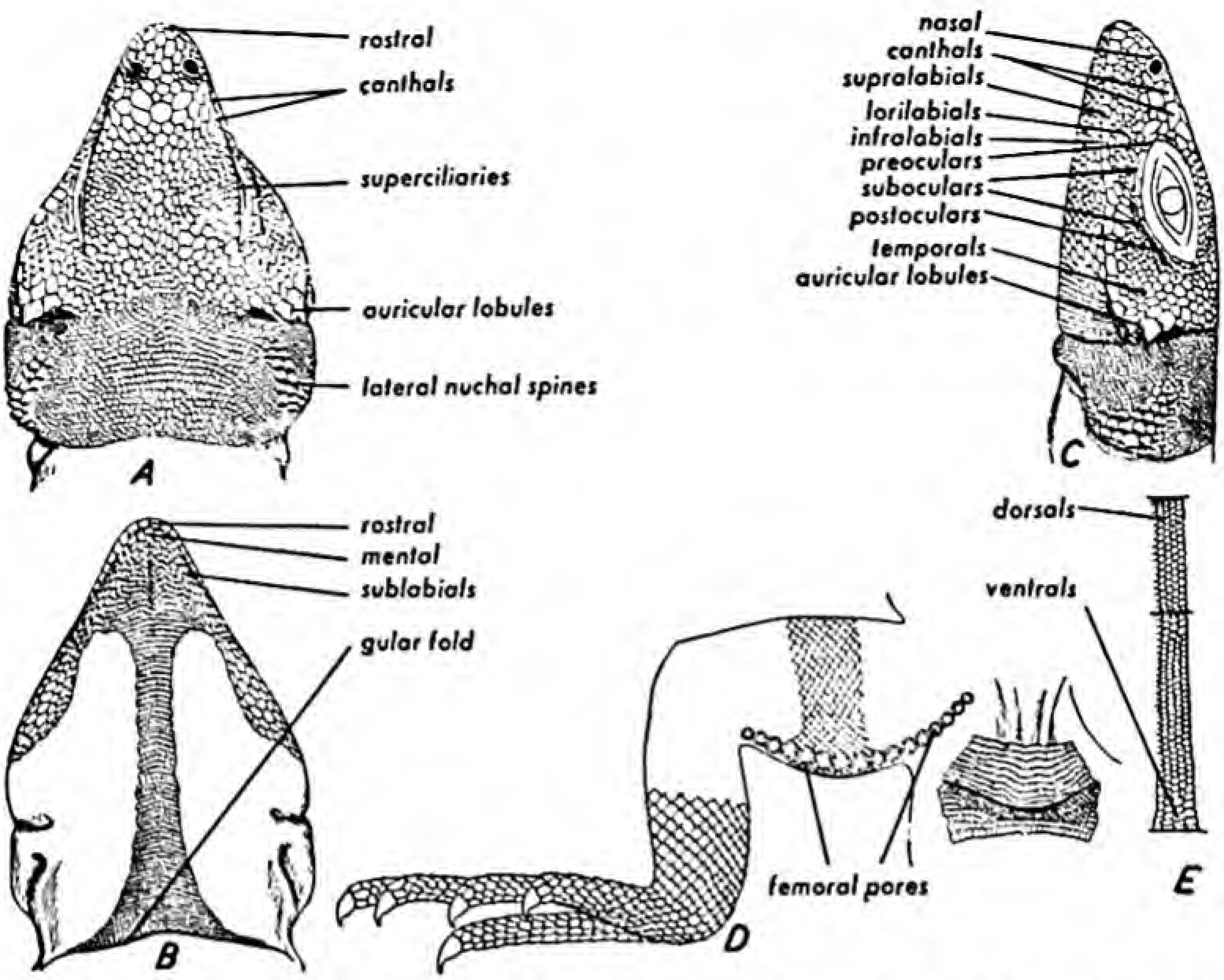


FIG. 62. Typical scutellation in *Sauromalus*, from *S. obesus*, Yampai Valley, Arizona. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

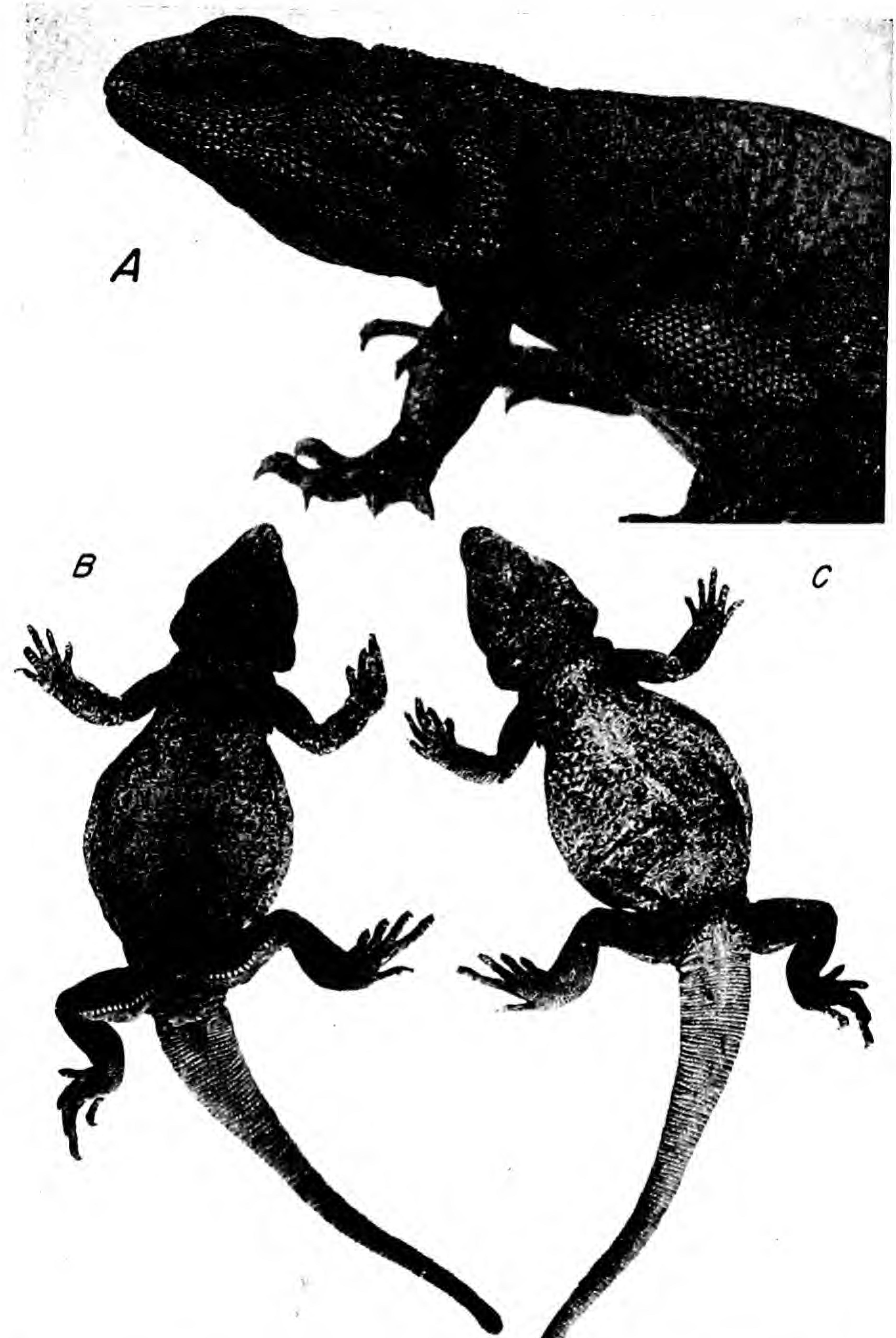
Northern Chuckwalla *Sauromalus obesus* (Baird)

(Figs. 37, 38, p. 88; Fig. 62; Pl. 15)

Range. Extreme southern Nevada, southwestern Utah, western Arizona, southeastern California, the northern half of Baja California, and probably northwestern Sonora. Type locality—Fort Yuma, Arizona. (Map 3, p. 486.)

Size. With the exception of the Gila monster this is the largest species of lizard definitely known from the United States. Adults reach their usual maximum size at about 210 mm. (8¼ in.) snout to vent. The tail is thick at the base, tapered toward the tip, and is of about the same length as the head and body. Specimens of this size have a body about 90 mm. (3½ in.) wide, and a head about 32 mm. (1¼ in.) wide at the level of the ears, excluding the ear denticles. The body and tail are distinctly flattened, the head a little less so. The limbs are stout, the hind legs a little the larger.

Color. Young specimens have 4 or 5 broad, brown crossbands on the body, and 3 or 4 on the tail. The light spaces between the crossbands are about half as wide as the bands themselves. As the young reach larger size, the dark crossbands on the body begin to break up by the formation of small, irregular, light areas within them. The bands still remain visible on specimens with a


A
B
C
D

snout-vent length of about 150 mm. (6 in.). In larger adults they disappear completely except near the rump and across the shoulders, where there is a vague concentration of black or dark brown pigment. The light areas become red. The tail bands change relatively little, not breaking up as do the body bands; they vary greatly in distinctness, however, sometimes being very prominent, at other times fading almost completely. Specimens thought to have white tails may actually be in the light phase of their pattern repertoire, or may just have failed to shed the outer "skin" of the tail; apparently the tail "skin" does not shed readily for some reason.

Live adults are rather brightly marked, but are extremely variable. Some show a great deal of red both above and below. One fairly typical adult male, in life, had the

> Top of head dark brown, nearly black, with many yellow scales scattered over the occiput and head and small patches of orange in the ear just behind the tympanum; back speckled with black scales in lichen-like pattern; about an equal number of orange and of yellow scales, evenly dispersed, covering most of back; shoulder patches large, dark brown, and dorsal surface of limbs dark brown; feet spotted with yellow; head and limbs beneath, black; belly almost uniform dark morocco to brick red; tail abruptly lighter than rest of body, deep colonial buff, faintly banded with three broad rings of deep olive buff (Camp).

The ability of this lizard to change its color in response to change in light, temperature, movements, etc., is well known and has been exclaimed over by numerous observers. For an accurate account of some changes due to variation of light intensity, see Atsatt.

Scalation. See Fig. 62. All the scales of this animal are small, those on the tail the largest. Most of the scales are flat and lack sharp points, but some on the sides of the neck and body are somewhat enlarged and pointed. All the head scales are flat and more or less square, rectangular, or circular, none overlapping. Those toward the middle are largest; the labials are not large, but distinct. There is a fold across the posterior part of the throat, marked by tiny scales smaller than those preceding or following them. There are no enlarged postanal scales in males. Scales on the dorsal surface of the limbs are feebly keeled. The tail scales are in rings, all of equal size. There is a series of large femoral pores, 11 to 24 in number, averaging 16.5. The ear opening is large and oval, and protected by a series of 2 or 3 enlarged, thickened scales projecting over it from the anterior border.

Recognition Characters. The fat body, the uniformly small scales, the granular throat fold, and the lack of overlapping scales on the head (either superciliaries or labials) separate this species from all others in the United States.

Pl. 15. *Sauromalus obesus*. A, southern California; Gloyd photograph. B, C, Victorville, San Bernardino County, California; male. U.S. Fish and Wildlife Service photographs. D, no locality; young.

Adults cannot possibly be confused with anything else, for there are no other lizards of this size known in this country, except the Gila monster, which is much different. The giant false uta is somewhat similar, but has, among many other differences, overlapping superciliary scales. The only other lizard of a size comparable to the chuckwalla that *may* occur in the United States is the northern false iguana; this can be distinguished by the series of enlarged scales extending along the middle of the back.

Habitat. These lizards are restricted to areas with large rocks and boulders, usually on barren hills and mountains below 4000 feet. They also occur in ancient lava beds. They sun themselves on the rocks during the day, and at night, or when disturbed, seek refuge in the cracks and crevices of their abodes. They are very wary and easily slip into concealment while the observer is still several hundred feet away. When found in rock crevices, they swell their bodies by inflating the lungs so that the rough skin is very tightly applied to the walls of the crack. Thus they are extremely difficult to extract. It is said that ruthless collectors can counter this defense by pricking the lungs and thus deflating the animals; this procedure is frowned upon, however, not only by collectors who have tried it and found it impractical, but also by those who have esteem for good sportsmanship and humane considerations. A more effective, sporting, and humane procedure, described by Klauber, is "to take a soft iron wire and thread it through the crevice in back of the chuck; then by sawing and pulling on the two ends he can usually be brought out. Another scheme, if his head can be reached with a stick, is to tap him repeatedly on the nose, whereupon he will accommodatingly back out." A crowbar, shovel, and piece of fishing line are also valuable pieces of equipment for securing specimens.

Habits. The food consists entirely of plant matter, including the tenderer parts such as leaves, flowers, and fruits. In their native haunts these lizards utilize almost any plant as food. In captivity they will eat grass, cantaloupes, watermelon, bananas, lettuce, and radish tops, among other things.

"While chuckwallas are usually rather tame, in twisting about endeavoring to escape they will occasionally slash with their tails." This habit perhaps is a holdover from the time when the tail may have had spines, as do our present-day false iguanas (*Ctenosaura*), which lash freely and very effectively with their very spiny, rough tails. "When annoyed they open their mouths and will sometimes try to bite" (Klauber). Like their not too distant relatives, the false iguanas, these lizards are prized as food by some of the human inhabitants of their range. Hawks and other birds of prey also are their enemies.

It seems probable that, like many other lizards, the chuckwallas spend most of their time in a rather restricted zone (cf. Bogert).

Their breeding habits are practically unknown. Suspected breeding activities in cracks in rocks have been observed in May and June. One female is recorded with 6 eggs in the body. Presumably the eggs are laid in the rock

crevices. They are notably late in emergence from hibernation, as is to be expected of such a large species, appearing about a month after *Uta stansburiana.*

The inflation response so characteristic of chuckwallas is, of course, an inflation of the lungs. Salt has briefly described the lungs and the supposed mechanism of inflation.

When inflating, the chuckwalla appears to inhale to the normal point. The animal then makes a series of swallowing motions during which it appears to force air down the trachea with the tongue. During the swallowing, it appears that the tongue is held over the internal nares, sealing the mouth cavity. At the end of each swallow the animal presses the end of the glottis between the tongue and the roof of the mouth to prevent deflation. With the lungs thus closed it takes in another mouthful of air and repeats the process. When entirely inflated the animal probably holds the glottis with the tongue. The breath is held for a protracted period. The maximum time has not been determined. . . . In super-inflation there is an increase of 300 per cent in the lung volume over normal respiration volume, with a similar increase of 58 per cent in the torso volume.

Problems. The course of the life history of this species furnishes an attractive problem. It is a curious fact that practically nothing is known of the life histories of the larger species of lizards of our southwest and Mexico.

References. Atsatt, 1939, pp. 249–250, pl. 9 (*lit. cit.*); Bogert, 1930, p. 6 (*Calif.*); Camp, 1916, p. 522 (*Calif.*); Klauber, 1939, p. 86 (*Ariz.*); Salt, 1943, p. 193, inflation mechanism (*lit. cit.*); Van Denburgh, 1922, pp. 86–93, pls. 3, 4 (*gen. lit.*).

The Sand-Lizard Section

Three genera comprise this closely knit group: *Callisaurus, Holbrookia,* and *Uma.* All have oblique labials, granular dorsal scales, small head scales, a gular fold, a peculiar median, triangular postmental, several prominent postlabials, and much the same habits. All live on more or less loose sandy soil, where their long legs and toes are used to advantage. They have scoop-shaped heads and more or less flaring labial regions, and the lower jaw is more or less countersunk; all these features are adaptations that permit ready burrowing under the surface of the sand. Their tails are relatively short and dorsoventrally flattened, and many species have black bars across the undersurface of the tail.

From the viewpoint of lack of prominent morphological modifications *Callisaurus* seems the most primitive of the group, for *Holbrookia* does not have the ear opening, and *Uma* has prominent digital fringes. *Uma* obviously is specialized along *Callisaurus* lines, while *Holbrookia* could be interpreted as a reversion. *H. texana* in the West is very much like *Callisaurus,* and is supplanted farther east by a small-bodied series of forms (*maculata* and *pro-*

pinqua), one of which still shows evidence of ventral caudal bands. There is also the possibility that the small species of *Holbrookia* are most primitive, the ear-opening loss being their only marked specialization.

The Earless Lizards

Genus *HOLBROOKIA* Girard

This is a puzzling genus of about eleven forms, eight of which occur in this country; they comprise some three or four species, all of which, with one exception, are so alike that they must be carefully examined to be identified. The one exception—and it is a very outstanding one—is the greater earless lizard (*texana*), which is very different from the other members of the genus. In fact it is so distinct that some have thought it should be placed in a separate genus. Some details of the scutellation of a typical species are shown in Fig. 63.

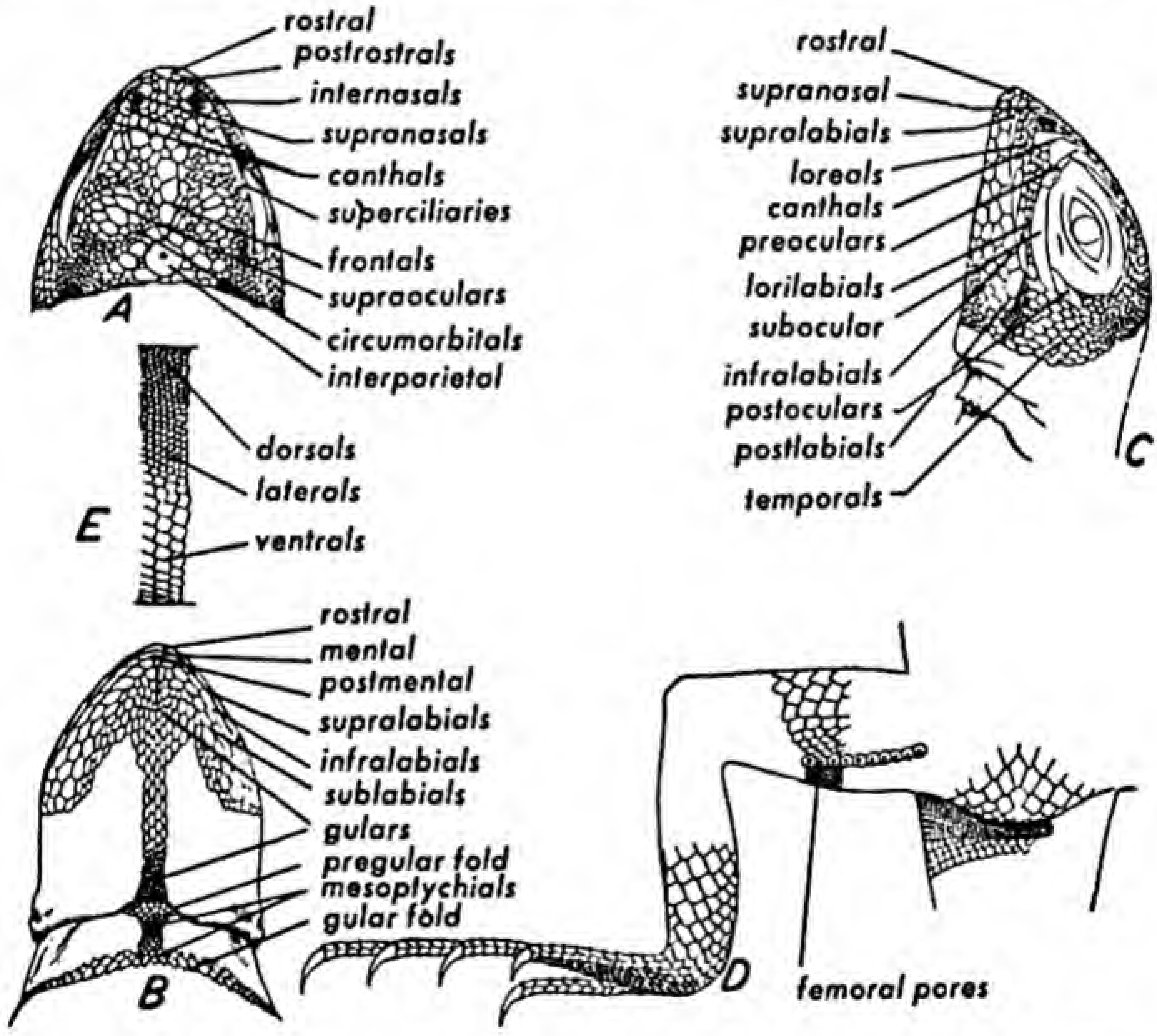


FIG. 63. Typical scutellation in *Holbrookia*, from *H. m. maculata*, Fort Kearney to Laramie, Wyoming. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

In habits and habitat all species are remarkably alike. They occur largely in sandy areas, generally rather dry. All are egg-laying.

KEY TO SPECIES OF *HOLBROOKIA*

1. Tail flat, with broad, black, ventral bands; lateroventral black marks placed far posteriorly, continued dorsally above the lateral fold, and slanting anteroventrally on belly .... *texana* (p. 134)
   Tail rounded; no ventral subcaudal marks save small spots in one subspecies; lateroventral marks placed farther anteriorly, not extending upon dorsal surface and slanting posteroventrally on belly .. 2
2. Several black spots under tail; dorsal pattern of large, well-defined spots equally sharp-edged on all sides; no light dots in pattern .... *maculata lacerata* (p. 122)
   No black spots under tail; pattern not as described 3
3. Dorsal body scales distinctly keeled, rather small .... *propinqua* (p. 132)
   Dorsal scales not keeled (although sometimes pointed and somewhat convex), larger, flat 4
4. Tail generally shorter than the snout-vent measurement, usually not over 51 per cent or more of the total length; the higher proportions are of males 6
   Tail as long as or longer than the snout-vent measurement, 50 per cent to 58 per cent of the total length; the lower proportions are of females 5
5. Femoral pores usually less than 12; spots usually very distinct, unless whole pattern is faded; relatively few dorsal light spots .... *maculata pulchra* (p. 124)
   Femoral pores usually 12 or more; dark spots usually rather obscured by numerous small, light dots, or by a dark ground color .... *maculata thermophila* (p. 129)
6. Dorsal and ventral surfaces practically a uniform white .... *maculata ruthveni* (p. 126)
   A dorsal pattern of dark spots or light dots usually evident; if pattern faded, the ground color not white or very light gray 7
7. Dorsal pattern of large, prominent, dark spots; light dots very few in females, more numerous in males; a dorsolateral and median light stripe usually evident; males with very little or no blue surrounding lateral black marks on belly; and gular region dimly reticulated or gray-suffused .... *maculata maculata* (p. 115)
   Dorsal pattern of dark spots obscured, especially in males; light dots very numerous, even in females; light stripes scarcely evident; males with blue surrounding the oblique, black, belly marks; gular region usually very distinctly suffused with gray centrally and mottled laterally in adult males .... *maculata approximans* (p. 119)

Northern Earless Lizard *Holbrookia maculata maculata* Girard
(Fig. 63, p. 114; Pl. 16)

Range. Southeastern Wyoming, eastern Colorado, southern South Dakota, nearly all of Nebraska, central and western Kansas, the western half of Okla-

homa, the northern part of the Texas Panhandle, and extreme northeastern New Mexico. Type locality—opposite Grand Island, Platte River, Nebraska. (Map 4, p. 487.)

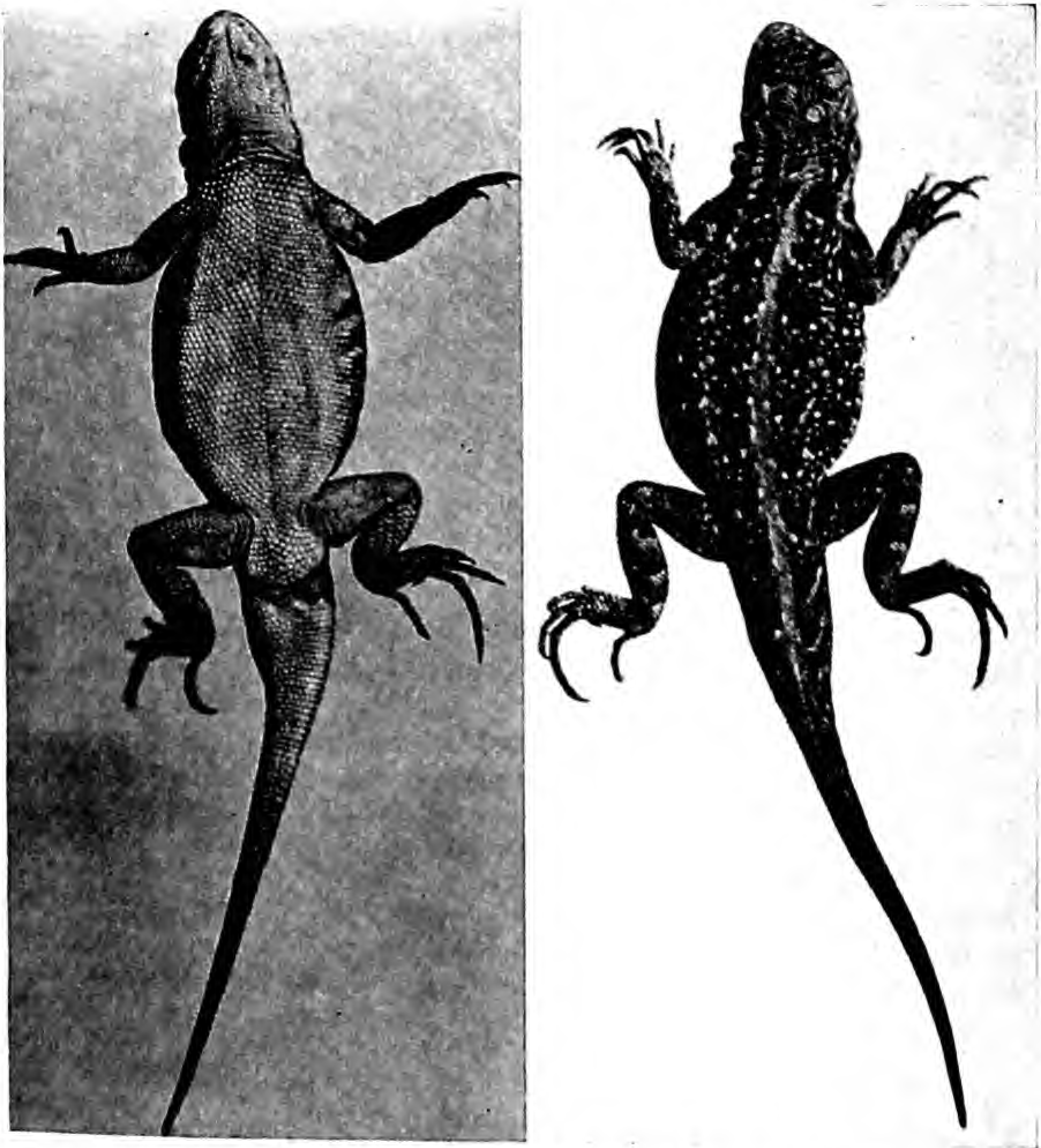
Size. Specimens seldom exceed 53 mm. (2⅛ in.) snout to vent, but a maximum of 61 mm. (2 7/16 in.) has been recorded. The tail is always at least a little shorter than the head and body in females (41 per cent to 49 per cent of the total length), but may be slightly longer in males (Burt gives range from 44 per cent to 58.3 per cent, average 49 per cent).

Color. Dorsal ground color light gray to gray-brown, frequently tinged with reddish laterally. A broad middorsal area is light gray, unmarked. On either side of this is a series of 9 to 14 dark brown spots on the body, and 3 or 4 others on the basal part of the tail. The spots blend with the ground color anteriorly where the margin is more or less straight, but posteriorly the spots become darker, and have a sharply defined, dentate border. There is a small light dot in each indentation. The dark spots are a little broader than long, and are bordered laterally by a rather dim, dorsolateral light line extending from the orbit to the base of the tail. Another lateral light stripe, frequently more or less blended with the light belly color, extends from axilla to groin. Between these two lines may be a uniform area of ground color, or a series of very dim spots similar to those on the back. Below the lateral stripe there may be a dim, narrow, gray stripe, or no markings whatever may be present; frequently the light stripe is broken by irregular lines in extensive areas extending ventrally from the lateral dark areas so that the stripe is scarcely distinguishable; in either case the lateral pigmentation terminates at the point where the enlarged belly scales merge with the small lateral scales. There may be feeble dark bars across the limbs. Usually on the head there is a dark, transverse, supraocular line, bordered behind by a light line interrupted medially. The tail color usually terminates laterally rather abruptly.

On the sides of the belly, usually just anterior to a point halfway between axilla and groin, are 2 black, diagonal bars, directed posteroventrally, extending from the extreme lateral belly scales and disappearing a short distance above the lateral fold. There may rarely be 1 or 2 similar bars posterior to these. They are always present in males, and usually also in females, although sometimes reduced. In females the belly is otherwise unmarked, except rarely for a gray suffusion in the gular region. In males the throat is usually grayish, and frequently there is some mottling or a barred pattern laterally.

Scalation. See Fig. 63. Dorsal scales very small, flat; lateral scales a little smaller, decreasing in size toward belly, but somewhat pointed and elevated near tips; belly scales larger, smooth, flat, grading into lateral scales. A prominent, granular, gular fold, and a smaller, pregular one just anterior to it. Supraoculars numerous, slightly enlarged, separated from median head scales by 1 or 2 rows of small scales. Femoral pores usually between 10 and 14. Enlarged postanals present in males.

Recognition Characters. The species *maculata* can be distinguished from all others of the genus by the absence of prominent keels on the dorsal scales, the relatively short tail (shorter than body in females, shorter also in males or only slightly longer), and the absence of broad, black bands under the tail.



Pl. 16. *Holbrookia maculata maculata.* Three miles east of Sharon Springs, Kansas; male.

The several subspecies of *maculata,* however, are very closely related and distinguished only with difficulty. The northern plains race, *m. maculata,* is distinguished by the distinctness of the dark spots, the absence of numerous light dots, the rather distinctly striped pattern, the absence of blue about the diagonal belly marks, the lack of a bright throat pattern in males, and the smaller size (seldom exceeding 53 mm. snout to vent). These are very vague

characters, yet an examination of many specimens from all parts of the range of the species leaves little doubt that the northeastern specimens are more or less uniformly different in appearance from other specimens. On the other hand, it has been impossible to characterize the race by means of the number of internasal scales (the average is about the same throughout the species), the extent of overlap of the labials (Nebraska specimens are like Arizona ones, and the variation is too great to permit a satisfactory definition of any differences), or by any other of the numerous characters in the head scutellation.

Habitat. Typically, more or less sandy soil is frequented, where vegetation is rather low or sparse and where there is little grass. The chalk beds of western Kansas are inhabited by considerable numbers. In central Kansas (Ellis County) Brennan reports them from the Mixed Prairie and Flat-Rock Hillside habitats. In western Oklahoma Ortenburger and Freeman reported:

> Individuals were taken in many different situations; one at the edge of a cotton field (Harmon County), one among dead tumble weeds; another in grass growing on a sandy soil with many rocks; others in short grass-cactus-mesquite country (Harmon County); others in furrows of newly ploughed fields; many on sand which supported very sparse vegetation (Texas County); many others on a dry sand bar of Coldwater Creek among small willows, sedges, and ragweed.

Habits. These are not extremely wary lizards, but they can be caught by hand only by resort to special means. On warm days they are very active and can be seen scampering about the bases of bushes. They retire early in the evening long before the sun actually sets. Mammal holes or other burrows are used as retreats during the night and on cold days. They are seldom found under rocks or other objects.

In western Oklahoma, Ortenburger and Freeman say:

> They were always seen in the shade of some small bit of vegetation and unless driven out they are usually not seen or taken. The female is regularly frightened from shelter first; then commonly the male will follow the female as she runs away. The male will often lie at least partially buried in the dry sand.
>
> Usually they were found in pairs and once (June 28) a pair was found copulating. They ran for over a yard before disengaging themselves. In all instances where pairs were observed, the two individuals were within a foot or two of each other.

Tihen and Sprague comment upon the amazing curiosity of these diminutive creatures.

> It was a frequent occurrence for them to appear while we were working in the quarry and watch us for hours at a time. In the summer of 1936, for over a week, one in particular was an almost daily visitor. He would arrive in the morning soon after we put in our appearance and take up a position near us, placing his front feet on a clod so as to be sure not to miss anything. In the hotter

part of the day he would seek out the shade of a particularly large clod, but would never leave us for any length of time.

The food consists of insects and arachnids, of which grasshoppers comprise nearly a half, and bugs (Hemiptera) about one fourth. "The finding of 28 chinch bugs and 12 other small insects in the stomach of a specimen collected in a wheat field in Ottawa County suggests that the spotted lizard may be of considerable economic importance in some sections" (Burt).

The breeding habits are practically unknown. Copulation, as indicated above, occurs in the spring (late June and probably early July). The eggs number 6 to 8 and are probably laid in August; in late July eggs measured about 12 x 18 mm.

Problems. It appears very doubtful that a practical, concrete means of characterizing this race and its relatives exists, yet until such a means is found there will remain indefinitely a problem in defining the ranges of the several subspecies, or even in defending their actual validity. Accordingly the genus, particularly the *maculata* group, merits a careful study perhaps more than any other in the United States.

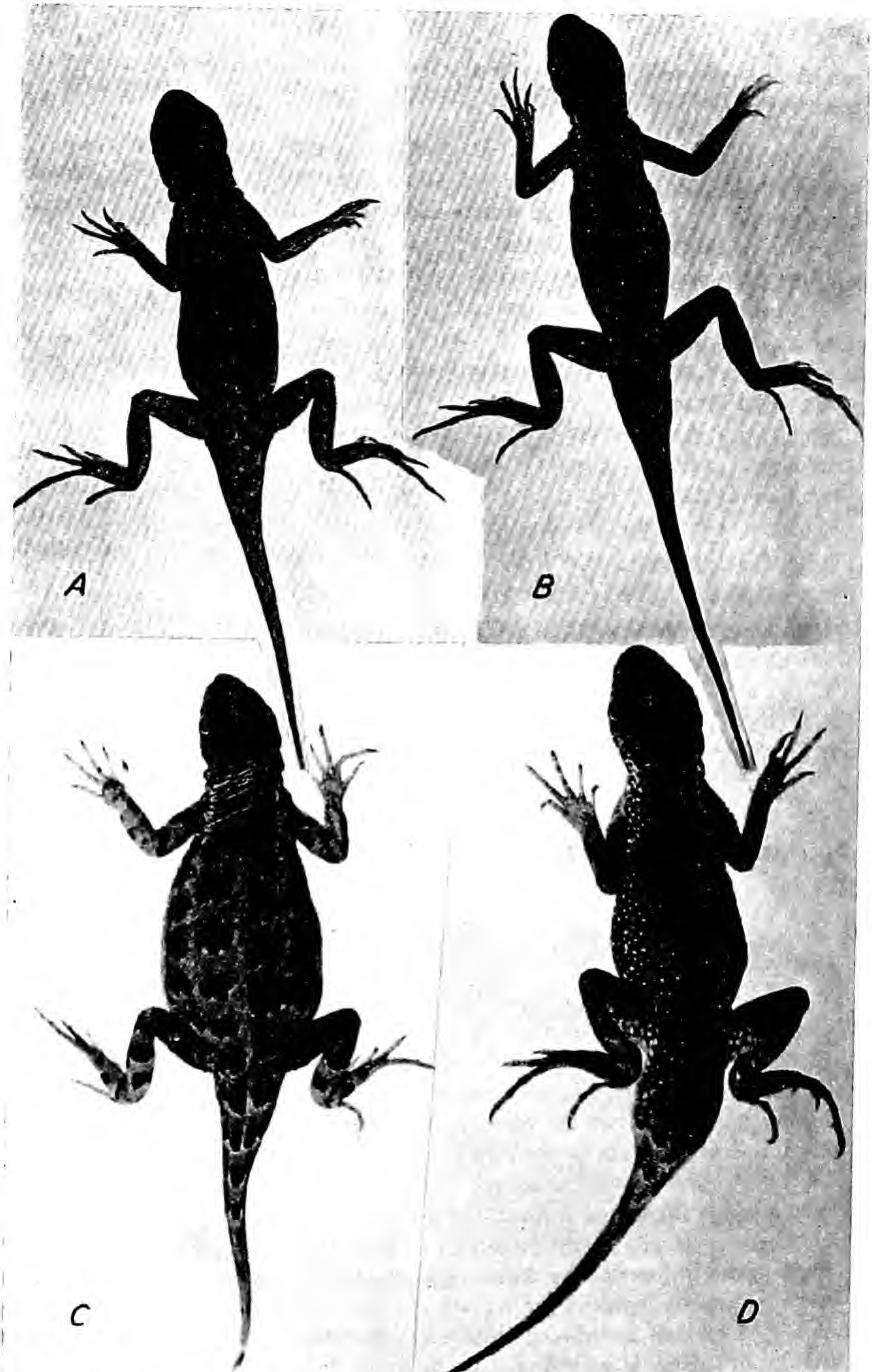
References. Brennan, 1938, p. 346 (*Kans.*); Burt, 1928, pp. 11–16, fig. 2, Kansas distribution, description (*Kans.*); *idem*, 1928, pp. 53–54, food (*Kans.*); Ellis and Henderson, 1913, pp. 70–71, figs 7–9, Colorado distribution (*Colo.*); Hudson, 1942, pp. 32–35, map 9, Nebraska distribution (*Nebr.*); Ortenburger and Freeman, 1930, pp. 178–179, Oklahoma records and habits (*Okla.*); Tihen and Sprague, 1939, p. 503, Kansas habits (*Kans.*).

Speckled Earless Lizard *Holbrookia maculata approximans* Baird (Pl. 17)

Range. Southeastern Utah, southwestern and south-central Colorado southward through most of New Mexico, eastern Arizona, and western Texas; southward in Mexico to central Chihuahua and Coahuila. Type locality—"Lower Rio Grande." (Map 4, p. 487.)

Size. Larger than *m. maculata*, frequently measuring over 53 mm. (2⅛ in.); the largest snout-vent measurement recorded is 61 mm. (2$\frac{7}{16}$ in.). The tail is generally shorter than the body, varying from 42 to 48 per cent of the total length in females, 42 to 50 per cent in males.

Color. As in *m. maculata*, except that the males have very numerous, small, light spots on the dorsal surface; the gular region is usually heavily mottled; and there is usually a distinct area of blue surrounding the diagonal belly marks; even in females the dorsal light spots are numerous. The dorsolateral and middorsal light lines are scarcely, or not at all, evident, and the dorsal dark spots tend to be reduced or obscured by other marks. In some specimens the dorsal surface is very finely speckled and lacks dark spots. Especially in



Pl. 17. *Holbrookia maculata approximans.* A, 3 miles east of Holbrook, Arizona; female. B, same locality; male. C, Sonoita, Arizona; female. D, same locality; male.

northwestern specimens, the dark spots are very small and rather broken up.

Scalation. As in *m. maculata* (Fig. 63); the pores vary from 8 to 13, averaging 11. A supposed difference in the narrowness and degree of slant in the supralabials simply does not exist.

Recognition Characters. From *m. maculata*, the race most easily confused with this, the chief differences are in pattern: the reduced or obscured dorsal dark spots, the presence of numerous light spots, the absence of a striped pattern, the presence of distinct blue areas about the black belly marks in males, and the distinctly marked throat in males characterize *m. approximans*. The size in *m. approximans* is also distinctly greater, specimens frequently exceeding 53 mm. (2⅛ in.) snout to vent.

Habitat. A plains species, generally occurring in open areas rather than in canyons and amongst boulders. It prefers sandy or fine, gravelly soil. In Arizona Gloyd observes that in the vicinity of the Huachuca Mountains specimens were taken only below 5000 feet.

Habits. Very little is recorded. The food consists of insects, chiefly ants and grasshoppers. Females taken as late as the first part of August still may carry large eggs in the abdomen. King records a specimen regurgitated by a large toad, *Bufo alvarius*. Camp had the novel experience of having a specimen "dropped near me by a small hawk which had killed the lizard by a severe blow on the back of the head." The same author (in Schmidt) continues:

> During a single warm day (July 2, 1921) spent in the Carrizo wash, eight to fourteen miles northwest of Adamana [Arizona] a large number of Holbrookia were seen and a series was collected. All were taken near or under small bushes in the hot, flat ground immediately above the low banks of the wash. None were noted on the mesas and uplands above. The lizards by remaining motionless and lying close to the light-colored soil made themselves inconspicuous. If approached carefully they could sometimes be captured in the hand. A female lizard which had been wounded, ran under my feet, and a male, seeing her actively squirming, became excited and seizing the back of her neck in his teeth, attempted copulation, twisting one hind leg around the tail and inserting one hemipenis from the right side. The female was nearly dead and the male allowed himself to be captured without attempting escape.

Problems. The exact area of intergradation between *m. maculata* and *m. approximans* remains a problem. I consider as intergrades specimens from the southern Panhandle of Texas (Potter and Swisher counties) and from Montoya, Quay County, New Mexico. Much more remains to be learned of this species, however, before the exact area of intergradation can be known.

It is not impossible that *m. approximans*, as here visualized, may consist of two races. Schmidt has distinguished northwestern specimens as another race, *m. campi*, but I have been unable to detect constant differences in the few specimens examined.

A recent note (Shreve) purports to record this race from Bagdad, Cali-

fornia. The locality or the identification must be in error. The westernmost locality known to me is 20 miles west of Kingman, Mohave County, Arizona.

The paucity of published information on the habits of this race is amazing considering the abundance of these lizards.

References. Gloyd, 1937, pp. 107–108, Arizona records (*Ariz.*); King, 1932, p. 176 (*Ariz.*); Ruthven, 1907, pp. 525–526, color, food, habitat (*Ariz.*); Schmidt, 1922, pp. 721–724, pl. 60, description, taxonomy, range (*gen. lit.*); Shreve, 1935, p. 185 (*Calif.*); Van Denburgh, 1922, pp. 170–175, pl. 14, description, localities (*gen. lit.*).

Band-tailed Earless Lizard *Holbrookia maculata lacerata* Cope (Pl. 18)

Range. Uncertain. The few records are widely scattered, and the distribution may be discontinuous. Known from northern central (Erath County) to southern central Texas (Bexar County) east to Waco and west to Crockett, Howard, Irion, Sterling, Tom Green, and Val Verde counties; southward into northeastern Coahuila. Type locality—Erath County; west of the Upper Brazos, Comanche County; on the Guadalupe River, Kendall or Comal County. (Map 4, p. 487.)

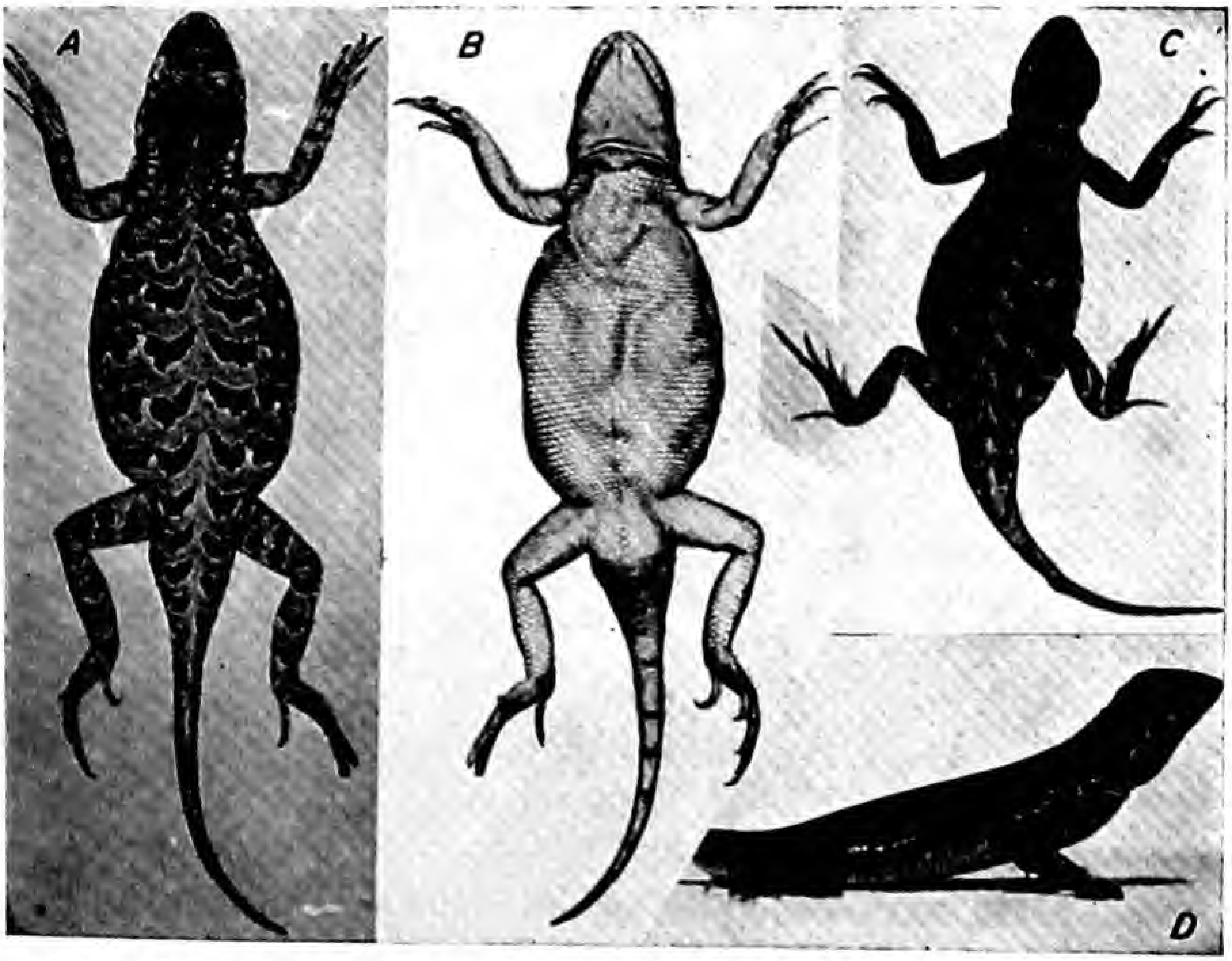
Size. The mazimum snout-vent length recorded is 65 mm. (2⁹⁄₁₆ in.). The tail is about as long as the head and body, varying from 48 to 51 per cent of the total length.

Color. A juvenile specimen has only 7 large, dark spots on either side of the middorsal line; they are longer than wide. There is a lateral series of similar spots, somewhat smaller, and below this another series of very irregular spots. The ground color is light brownish gray. There are no distinct light spots, although some of the dark spots appear to have light posterior edges. There are 4 small, lateral, abdominal, black marks. Under the tail there are 7 oval, black spots, not reaching the sides of the tail.

An adult female measuring 57 mm. snout to vent (2¼ in.) has a bold, clear pattern of very well-defined, evenly edged, dark spots on a light, slate-gray background; there are 7 to 8 spots on either side of the middorsum from shoulders to base of tail, and on the tail and neck the two series are continued. The anterior edges of the blotches are smoothly concave, the posterior edges undulate, generally convex; the blotches are about twice as wide as long. On each side of the body is another series of spots, but a little less well defined than the more dorsal series. There are conspicuous, bandlike spots on the hind legs, and less distinct ones on the forelegs. The belly is white. At the extreme lateral edge of the belly are 2 small black dots on one side, 3 on the other. There are 7 small, dark blotches under the tail, the posterior ones fading.

Scalation. The chief features of the scalation of the juvenile are the small

size of the scales in the frontal region, all broken in irregular, small scales; the conspicuous keeling of the scales on the dorsal surface of the base of the tail, and also on the rump (even the anterior dorsal scales are weakly keeled); and the keeled scales on the dorsal surface of the shank and on the anterodorsal surface of the thigh. The adult, however, shows none of these peculiar scale characters. The frontal scales are normal, and the keeling is as in *m. maculata.*



Pl. 18. *Holbrookia maculata lacerata.* A, B, Wimberly, Hays County, Texas; female. Maas photographs. C, D, Moody, Texas.

Recognition Characters. The juvenile specimen described above seems to be different from juveniles of other subspecies of *maculata,* as well as of other species of *Holbrookia.* Not only are the numerous black spots under the tail distinctive, but also the very large and few dark dorsal spots (only 7, longer than wide, as opposed to 9 to 14, wider than long), the small, equal scales in the frontal region, and the keeled scales on the rump, base of tail, and dorsal surfaces of the hind legs. Yet the adult possesses none of these characters save the bold pattern and subcaudal marks.

Absence of the lateral, abdominal, black marks does not seem to characterize this species, nor is the presence of black subcaudal marks completely unique, as I have seen at least one *m. approximans* (specimen No. 69058 in the

University of Michigan Museum of Zoology, from Potter County, Texas) with one large spot (perhaps more originally present, tail regenerated). Upon specimens such as this no doubt Ortenburger (1930, *Okla.*) included "*m. lacerata*" in "southwestern Oklahoma." The existence of such specimens makes the actual existence of *m. lacerata* as a distinct species very dubious, especially since Schmidt says two of the *m. lacerata* examined by him have no ventral tail spots. Accordingly there is no single character by which specimens can be identified as *m. lacerata,* except perhaps the distinct, bold, dorsal pattern. Even this may not be of regular or unique occurrence. On the whole it must be concluded that this race rests upon very tenuous grounds. The specimens which have been assigned to the race, however, are from an area not occupied by any other *Holbrookia* species, except *texana* and perhaps *propinqua,* to neither of which does it appear to be closely related. The range indicated borders that of *m. approximans* on the southeast. Only because of this geographic segregation does it appear probable that *m. lacerata* is a valid and distinct form.

Habits and Habitat. Presumably as in other races of *maculata,* but not specifically known.

Problems. The true status of this lizard is one of the most attractive problems offered in the genus. To settle it, however, much collecting in the areas included in and adjacent to its presumed range will be necessary. The paucity of specimens from these regions is amazing. Perhaps, as Schmidt suggests, this is a decadent form, declining in numbers.

References. Cope, 1900, pp. 292–293, fig. 32, description (*gen. lit.*); Schmidt, 1922, p. 718, taxonomy, range (*gen. lit.*).

Mountain Earless Lizard *Holbrookia maculata pulchra* Schmidt

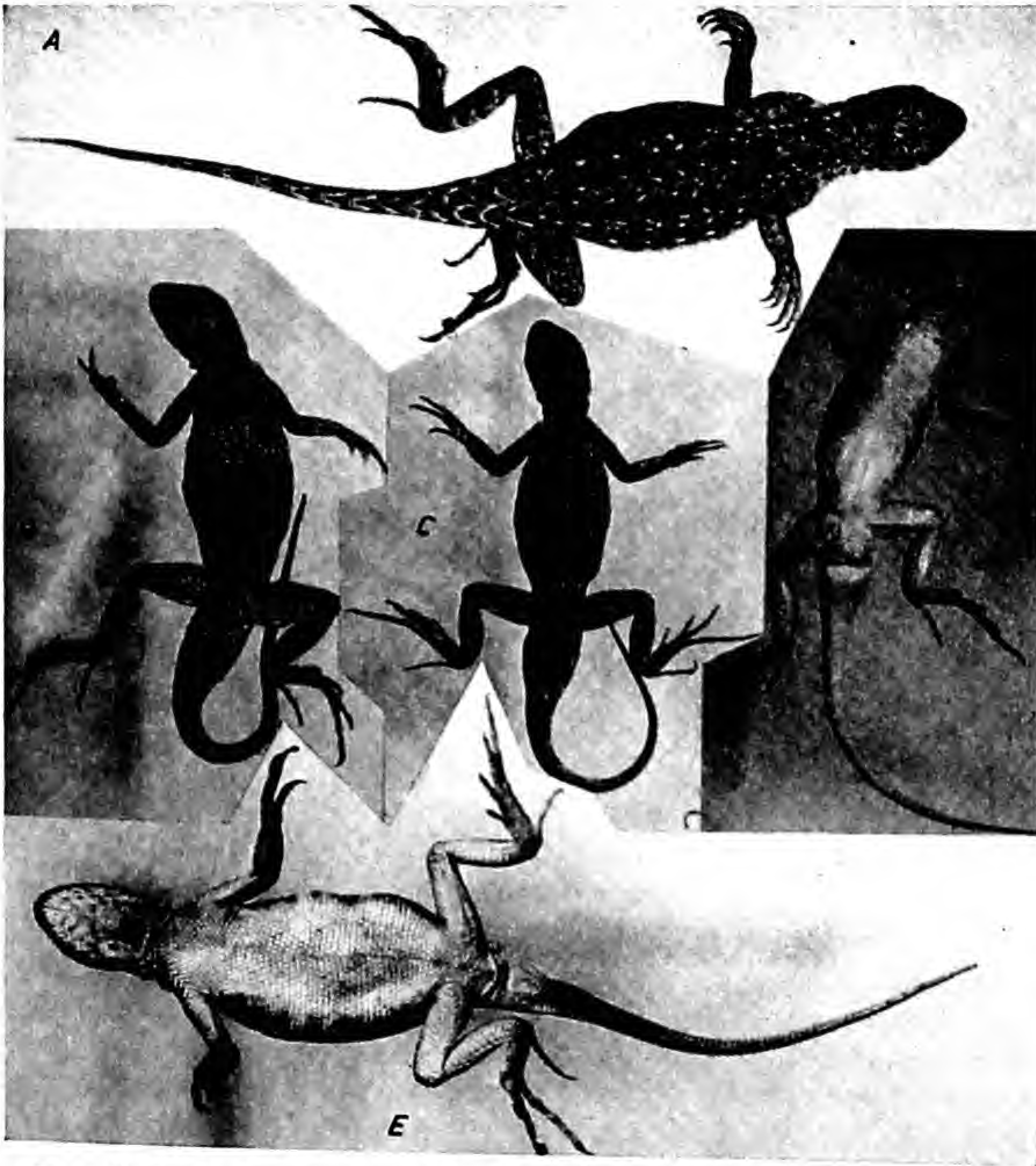
(Pl. 19)

Range. The Huachuca and adjacent mountains of extreme southeastern Arizona, above about 5000 feet. Type locality—Carr Canyon, 5200 feet, Huachuca Mountains, Arizona. (Map 4, p. 487.)

Size. Somewhat larger than *m. maculata,* frequently measuring over 53 mm. (2⅛ in.) snout to vent; the largest measurement, however, is only 58 mm. (2$\frac{5}{16}$ in.). The tail is distinctly longer than the body in males, varying from 51 to 56 per cent of the total length; in females it tends to be shorter, varying from 50 to 54 per cent of the total length.

Color. The pattern is basically like that of *m. maculata,* except that no stripes whatever are evident; the lateral row of dark spots is usually fairly distinct; and the dorsal spots show no tendency to fade. An irregular dark line, bordered above by white, is usually rather distinct in the posterior surface of the thigh. The ground color is frequently golden brown. Even in the largest

adults the dark spots are rather distinct. Small, light dots are present, but very few. The hind limbs are distinctly barred. The black bars on the sides of the belly are halfway between axilla and groin, surrounded by a narrow blue area,



Pl. 19. *Holbrookia maculata pulchra.* Between Patagonia and Nogales, Arizona. A, female; B, C, D, male; E, female.

and in males are quite large, almost as long as broad. The throat usually is mottled in adult males.

Scalation. Much as in *m. maculata* (Fig. 63). Dorsal scales a little larger, flatter; scales on dorsal surfaces of legs keeled; femoral pores 8 to 15, average about 12.

Recognition Characters. This race is a close relative of *m. approximans,*

which, like it, is of relatively large size. The two differ chiefly in pattern and tail length, *m. pulchra* having a longer tail, dark dorsal spots distinct throughout life, and few light dots. It somewhat resembles *m. maculata,* but lacks the light stripes, reaches a larger size, and has a longer tail.

Habits and Habitat. Gloyd reports:

We collected this species in July, 1931, on the Carr Cañon side of Carr Peak at an elevation of between 5500 and 6000 feet. This is the type locality (Schmidt, 1921, p. 1) although a somewhat higher elevation. The species was more abundant than the series collected would indicate for these lizards were very shy, often seeking shelter in deep crevices or beneath large boulders. They seemed more alert and more swift of movement than the *approximans* of the plain.

Problems. Although I have called *m. pulchra* a subspecies of *maculata* here, the situation needs much further study. What appear to be intergrades between *m. approximans* and *m. pulchra* occur at lower elevations in the Huachuca Mountains; the specimens have the distinctive pattern of *m. pulchra,* but short tails like *m. approximans. H. m. pulchra* is interpreted as a high-elevation race intergrading at lower elevations with the more widespread *m. approximans.*

References. Gloyd, 1937, p. 108 (*Ariz.*); Schmidt, 1922, pp. 716–718, pl. 54 (*gen. lit.*).

Bleached Earless Lizard *Holbrookia maculata ruthveni* Smith

(Pl. 20)

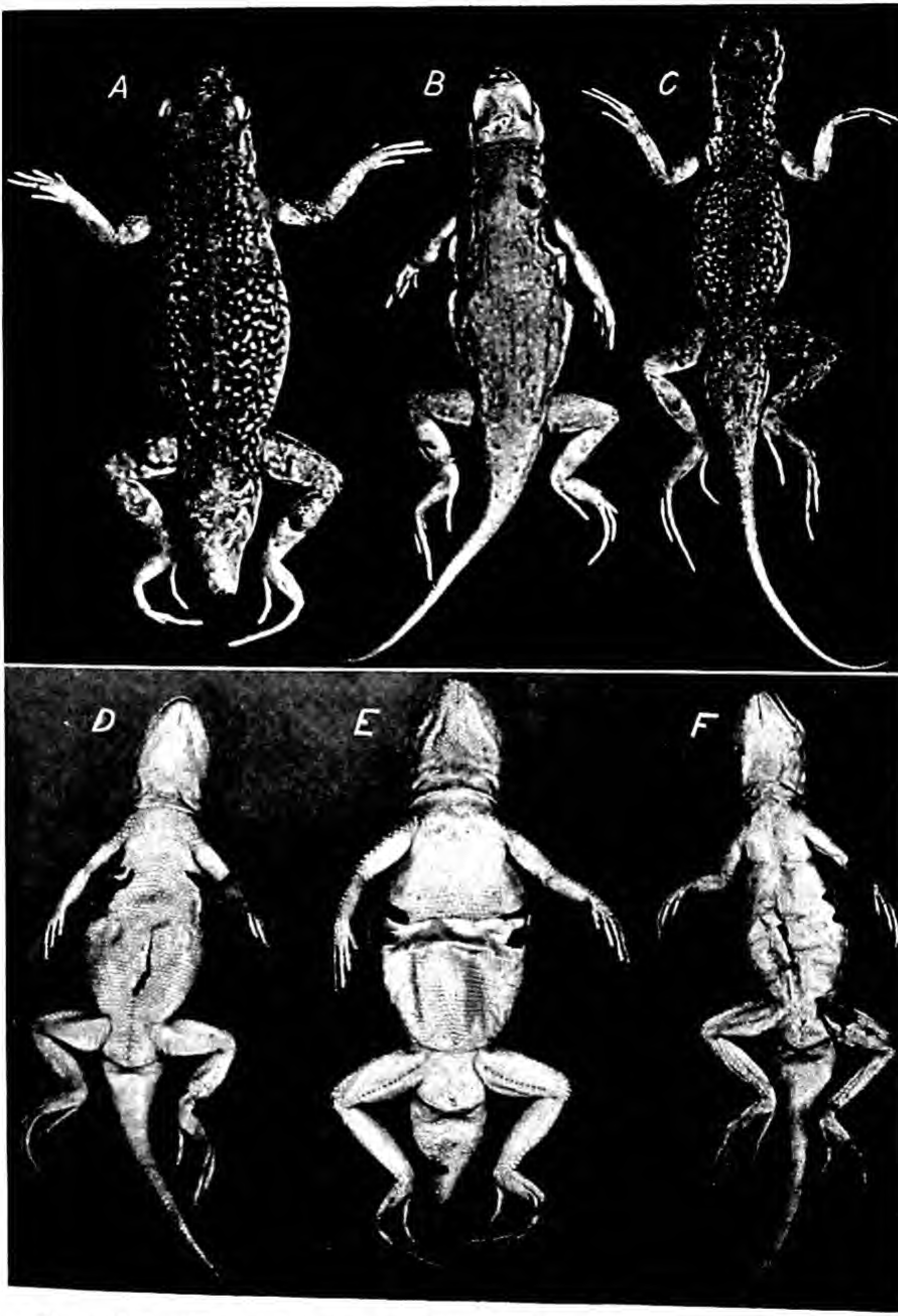
Range. The White Sands, near Alamogordo, Otero County, New Mexico. Type locality—the same. (Map 4, p. 487.)

Size. Probably about as in *m. approximans.*

Color. Ruthven describes the coloration of fresh specimens as follows:

Like the other lizards taken on the White Sands, these *Holbrookias* are remarkably light colored, there being no dorsal blotches as in *H. m. approximans.* The specimens obtained are nearly pure white with two jet black, crescentic, lateral spots which are placed slightly farther forward than in *approximans,* the foremost lying under the point of the elbow in the former, generally behind it in the latter. These slight differences serve to ally the White Sands specimens with *H. m. flavilenta* and to distinguish them from *H. m. approximans.*

In one specimen (No. 113) the color of the dorsal surface is uniformly grayish white, except for faint traces of dusky on the hind limbs, sides of head, and base of tail, and numerous faint spots of orange yellow that at a distance give a slightly pinkish appearance to the body. The head is light golden yellow above. There is a faint pinkish line extending from the outer canthus along the sides of the body and base of the tail, and another from the angle of the mouth to the groin, which is continued along the inner and outer sides of the thigh and base of tail. Belly creamy white, immaculate.



Pl. 20. *Holbrookia maculata ruthveni.* White Sands, New Mexico. A, C, E, F, male; B, D, female. Maas photographs.

Two other specimens (Nos. 473–474) are almost identical in color with the last, except that the dusky markings on the back are slightly increased in amount, making the orange spots somewhat more distinct. In No. 474 the upper surface of the head is also marked with darker.

Three others, while also very pallid, are a little darker than those described above. In the darkest individual (No. 472) the ground color is light gray, with numerous small dark spots interspersed with orange colored ones; the dark spots distinct or obscure but without definite arrangement. The amount of dark pigment is greatest on the upper surface of the limbs and tail. The color of the head is light golden yellow, that of the under surfaces the same as in the other two specimens. The pinkish lateral line is not discernible.

Scalation. The type has 2 rows of scales between interparietal and the 1 or 2 rows of granules (circumorbitals) surrounding the supraocular area; a median series of frontal scales; 3 rows of internasals; 3 scales bordering rostral behind, between anterior infralabials; 2 canthals, no subnasal; rostral in contact with a row of postrostrals; 4 loreal rows, 3 between anterior canthal and supralabials; a complete row of scales between enlarged supralabials and subocular; supralabials low, elongate. Dorsal scales small, smooth; lateral scales smaller, somewhat protruding; ventral scales smooth, flat; scales on dorsal surfaces of limbs very weakly or not at all keeled; only distal caudal scales keeled. Femoral pores 11 to 13.

Ruthven gives a variation of from 7 to 14 in femoral pore count of other specimens.

Recognition Characters. This race, restricted to the White Sands of southern New Mexico, is a local population of very white specimens with no trace of pattern save for small, light spots. It is not the same as the spotless specimen described as *flavilenta* by Cope; spotless holbrookias, of several forms, are fairly common, but these are not bleached as are the White Sands specimens; they have the normal gray or brown dorsal ground color.

Habits and Habitat. According to the observations of Ruthven,

> this *Holbrookia* was only found on the White Sands, although it probably occurs also in the Atriplex association. In this habitat it is quite common on the dunes, but very difficult to observe owing to its shyness and protective coloring. Usually the first glimpse that one gets of an individual is a flurry of sand up the side of some distant dune. When the lizard stops the orange tint of the pale ground color harmonizes so perfectly with the delicate buff or pinkish hue which the sands take on in intense sunlight, that even when looking directly at it from a distance of a few feet it is difficult to differentiate the form from the background.
>
> It runs about on the sides of the dunes, picking up its food which consists of ants, small beetles, and spiders. When surprised it dashes up the dune; taking refuge in the bushes or ground squirrel holes on the summit. Females taken in July contain large eggs.

Bugbee reports, "Several kept in captivity in a box containing white sand were observed to dig into the sand although not to the extent as the next

species [*Cnemidophorus perplexus*]. Often they barely covered their bodies allowing the head to remain free or at least the eyes exposed."

Problems. The most interesting problem this form presents is the investigation of the variability of the peculiar bleached appearance. As remarked above, this is apparently a genetic character, but carefully controlled experiments to prove or disprove this assumption have never been published.

As a rule it is not wise, in herpetology, to give names to local populations, even though well isolated. In the present case, the White Sands population has gained such notoriety because of the bleached coloration—apparently an adaptation to the white environment—that it is convenient to have a name for it. In fact, others have recognized it but have used the name *flavilenta*, which, as stated above, is based simply upon a specimen with normal ground color but lacking the dark spots. The disappearance of the dark spots is a frequent phenomenon throughout the range of *maculata*, but nowhere, except at the White Sands, do bleached specimens, practically without a ground color, occur. Specimens kept for over a year by Dr. Stuart have, he has told me, retained their white coloration even under experimental laboratory conditions, so the adaptation would appear to be not a transitory feature, as Atsatt (*lit. cit.*) has suggested, but rather a genetic character.

References. Bugbee, 1942, p. 317 (*N.M.*); Ruthven, 1907, pp. 523–525, color, variation, habits (*Ariz.*); Schmidt, 1922, pp. 720–721, taxonomy (*gen. lit.*); Smith, 1943, pp. 339–344, taxonomy (*N.M.*).

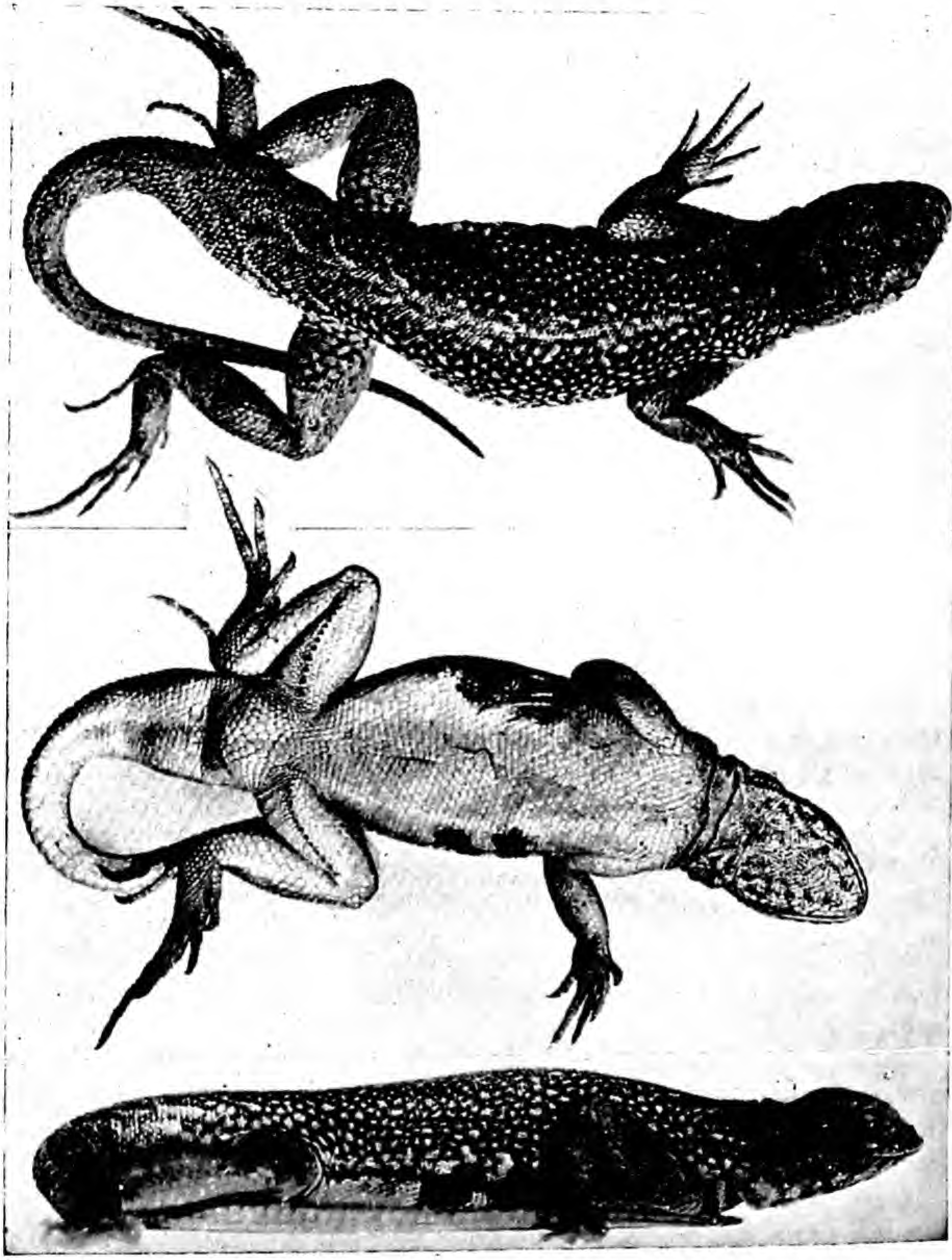
Western Earless Lizard *Holbrookia maculata thermophila* Barbour

(Fig. 40, p. 88; Fig. 64; Pl. 21)

Range. Central southern Arizona southward through central Sonora to near its southern border. Type locality—San José de Guaymas, Sonora. (Map 4, p. 487.)

Size. A large species, reaching 75 mm. (3 in.) in males, 65 mm. (2$\frac{9}{16}$ in.) in females, snout to vent. The tail is longer than the body in both sexes, varying from 50 to 57 per cent in females, and from 51 to 60 per cent in males, of the total length.

Color. Much as described for *m. maculata*, with 9 to 11 dark dorsal blotches on each side of median line, and a similar, but much less distinct series on the sides. There are no light stripes, except sometimes on the neck. The dorsal dark spots may be well defined or rather vague. There are numerous relatively large, light spots scattered on the sides of the body. The labial region is usually barred, and the gular region mottled, in males. There are 2 rather large, black, diagonal bars on either side of abdomen, becoming brown and shortly disappearing above the lateral fold; they are surrounded by a fairly extensive light blue patch.



Pl. 21. *Holbrookia maculata thermophila*. Nogales, Arizona; male.

Scalation. Dorsal scales flat, relatively large (compared with others of the genus); scales on dorsal surfaces of limbs keeled. Generally the supraoculars merge with the median dorsal head scales at several points, the usual rows of small scales bordering the supraocular area being largely absent (Fig. 64; compare with Fig. 63A). Femoral pores 10 to 16, average about 13.

Recognition Characters. In scale characters the most distinctive feature of *m. thermophila* is the reduction of the row of small scales (circumorbitals) bordering the supraoculars medially; the supraoculars, or a part of them, are usually in direct contact with the median head scales; this character is not invariable, but occurs in no other species of the genus in the United States. The tail is longer than in the other subspecies of *maculata,* except for *m. pulchra.* From the latter race *m. thermophila* differs in having numerous distinct light spots on the sides of the body, less distinct dorsal blotches, the somewhat higher average femoral pore count, and the reduction of the scales bordering the supraocular scales. From *m. approximans* it differs in having a longer tail, in the supraocular character, in having fairly distinct lateral blotches, and in the larger size. There are other minor differences.

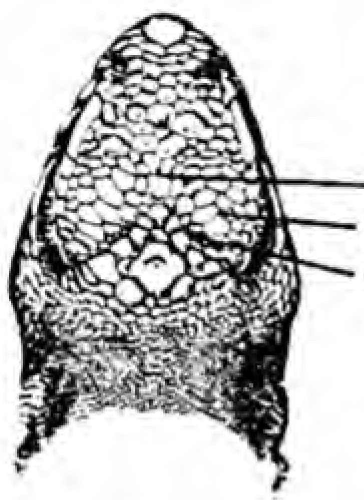


FIG. 64. *Holbrookia maculata thermophila,* top of head. From Schmidt.

Habitat. Gloyd records the race from "the cholla-sahuaro-ocotilla desert of the Cañada del Oro, twenty miles north of Tucson."

Habits. Presumably much like those of the speckled earless lizard. MacCoy records the occurrence of spiders and insect fragments in the stomach.

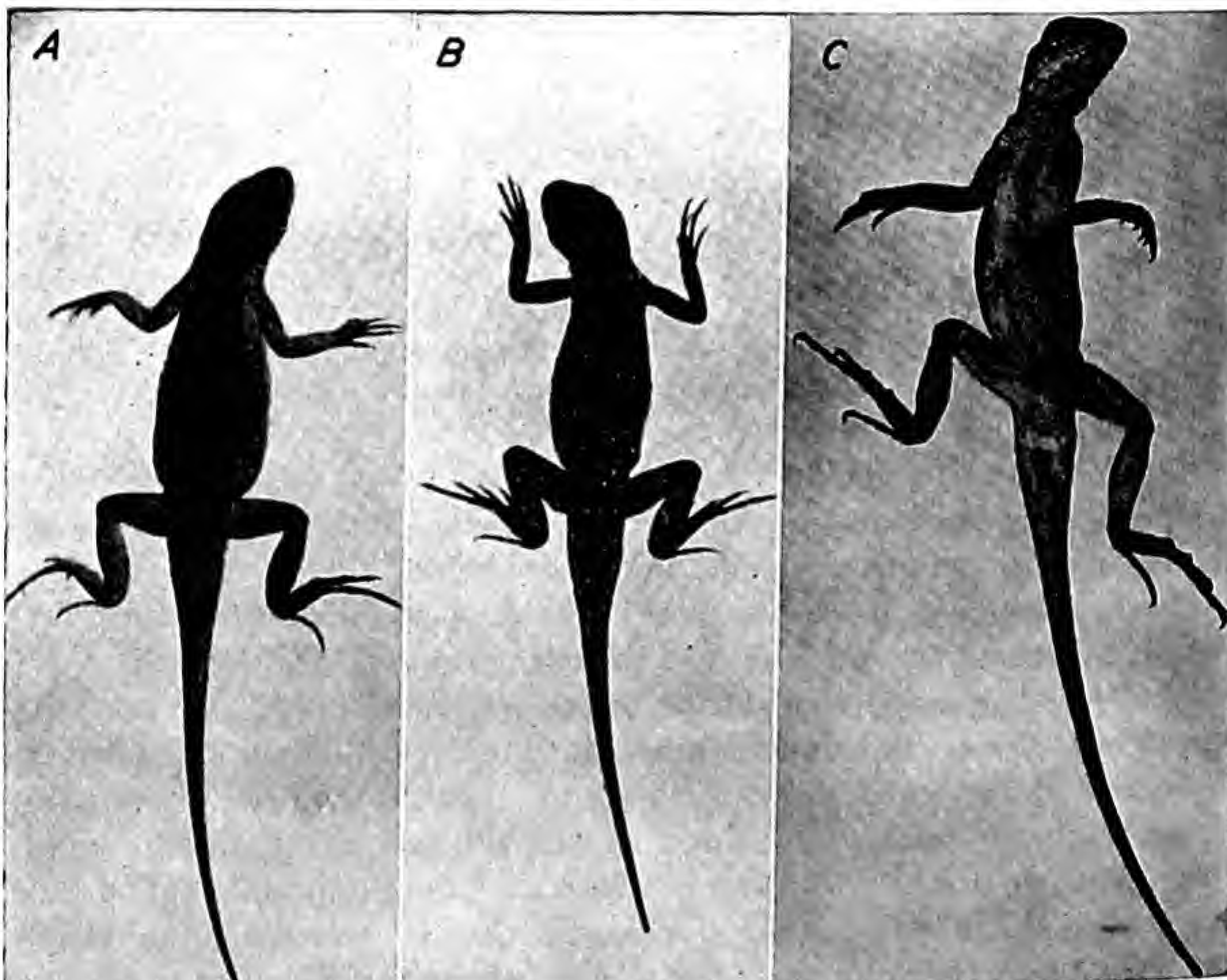
Problems. The assumption that *m. thermophila* and *m. pulchra* are subspecies of *maculata* needs much further study before confirmation. As others have pointed out repeatedly, the tail length character will not always distinguish *m. approximans* from the other two forms; this is partly because of the natural variability of the forms, which are not wholly different in this respect, but also, it would appear, because intergradation occurs in intermediate territories between all these forms. The several forms appear to occupy adjacent geographic ranges; and, because of the overlap of characters in remote parts of the range, complete intergradation at points where the ranges meet is to be expected and does appear to occur. In the supraocular character, also, there is a trend in *m. thermophila* northward toward the condition normal to *m. approximans.* Since the differences between the several races are not constant and appear to blend in intermediate territories, it does not seem unwise to consider all members of the group as subspecies of a single species;

this arrangement is compatible with, and supported by, geographic evidence. The life history is unknown.

References. Gloyd, 1937, pp. 98, 107 (*Ariz.*); MacCoy, 1932, p. 16 (*Ariz.*); Ortenburger, 1926, p. 105, brief notes, Arizona records (*Ariz.*); Schmidt, 1922, pp. 714–716, taxonomy, variation, distribution (*gen. lit.*); Smith, 1935, pp. 194–195, pl. 27, fig. 1, pl. 28, fig. 4 variation, taxonomy (*lit. cit.*).

Keeled Earless Lizard *Holbrookia propinqua* Baird and Girard (Pl. 22)

Range. Central southern Texas, from near Brownsville north to San Antonio, west about to the Pecos River, east to Refugio County. Type locality—between Indianola and San Antonio, Texas. (Map 5, p. 487.)



Pl. 22. *Holbrookia propinqua.* A, 10 miles south of Falfurrias, Texas; female. B, Somerset, Texas. C, Poteet, Texas; male.

Size. Maximum snout-vent measurement 59 mm. (2⅜ in.) in males, 59.5 mm. in females. Total length, maximum 141 mm. (5$\frac{9}{16}$ in.) in males, 127 mm. (5 in.) in females. The tail is notably shorter in females, 51 to 61 per cent (average 55 per cent) of the total length, whereas in males it is 56 to

61 per cent (average 58 per cent) of the total length. The hind leg varies from 71 to 93 per cent of the head-body length.

Color. In adult males the dorsal surfaces of body, limbs, and tail are olive gray to brownish gray; top of head a little paler; an area near middorsal line is unmarked, but on the sides are numerous small, light spots yellow to bluish in color. In a dorsolateral position, a series of 8 or 9 dark spots may be present on either side; the spots fade anteriorly into the ground color, but their posterior edges are well defined, rather dark, and strongly undulate; a light spot may be present in the angle of each indentation of the dark spots. The dark spots, when present, continue upon the tail, where those of either side fuse, become smaller, and toward the tip disappear. The limbs may have vague, transverse, dark bands or tiny light spots.

In males the throat is suffused with gray, in which irregular light areas may be discerned. On the sides of the belly are two diagonal dark lines, a little nearer axilla than groin, slanting posteroventrally, disappearing before reaching the dorsal surface.

In females the entire ventral surfaces are white or cream, unmarked; in life they may be pinkish. In males, also, in life the light areas on the sides of the body may be pinkish.

Scalation. Supraoculars numerous, distinctly enlarged, separated from median head scales by 1 or 2 rows of small scales; interparietal separated from supraorbital semicircles by 1 row of relatively large scales; usually a distinct subnasal present on a line with the 2 canthals; usually 5 elongate, strongly diagonal supralabials; a very small mental; a distinct, granular, gular fold, preceded by somewhat enlarged scales; a feebly defined pregular fold anterior to this. No ear opening. Dorsal scales very small, distinctly keeled, pointed; lateral scales projecting, smaller than dorsals; ventrals 3 or 4 times as large as dorsals, smooth, flat. Enlarged postanals present in males. Femoral pores 12 to 19, average 16.

Comparisons. The only other earless lizards in Texas, where *propinqua* occurs, have smooth dorsal scales, consistently lack a subnasal, and have shorter tails. Another distinctive feature is the absence of blue about the diagonal, lateral belly marks in males.

Habitat. Abundant in very sandy soil with sparse, low vegetation. On Padre Island, where the sand dunes are relatively large and wandering, the lizards are very common near the edges of the dunes.

Habits. Presumably as in other earless lizards. Nothing specifically about this species is recorded.

Problems. The almost complete lack of published information about the life history of this species suggests a very interesting problem for field work. Taxonomically, its relation to a poorly known Mexican form, *bunkeri*, is an interesting problem; so also is the status of the Padre Island population. Direct comparisons I have made of samples of the latter with mainland speci-

mens have not borne out the differences that at first appeared to segregate the two groups. There is no average difference in maximum size attained. Even if some slight difference were demonstrated, the superabundance of lizards on Padre Island, as compared with most places on the mainland, bespeaks a favorable environment. In such cases a somewhat larger size, caused by the favorable environment only and not by any genetic differences, is not inconsistent with expectations based on many other species.

The range of the species is not well defined. It is odd that it has not been recorded from Mexico in recent years; there is only one dubious record from that country ("Tamaulipas").

References. Cope, 1900, pp. 289–291, fig. 31, description (*gen. lit.*); Harper, 1932, pp. 15–17, redescription (*Tex.*).

Greater Earless Lizard *Holbrookia texana* (Troschel)

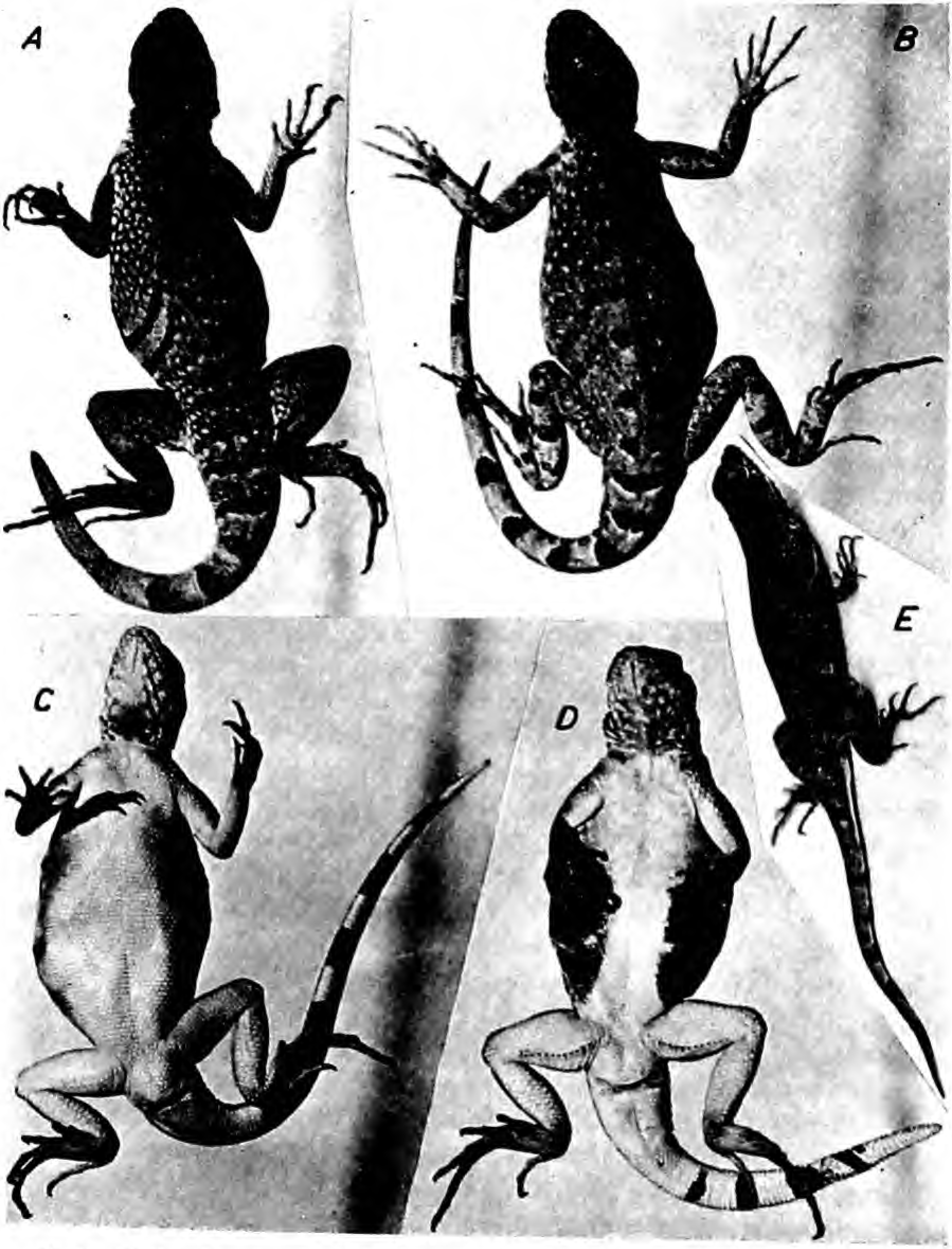
(Figs. 36, 41, p. 88; Pl. 23)

Range. Southern and western Texas, west to central Arizona, and southward through northern Mexico. Type locality—Neubraunfels, Guadalupe River, Texas, at Lat. 28° N. (Map 5, p. 487.)

Size. This, as the name implies, is the largest of all the earless lizards. Compared with most other lizards, it is of moderate size, the largest males measuring about 70 mm. (2¾ in.) snout to vent, and females reaching a maximum of about 63 mm. (2½ in.). The tail is 1⅙ to 1⅓ times the body length, longer in males than in females. The body and tail are somewhat flattened, the limbs well developed, the toes long; the hind legs are markedly larger than the forelegs and about ⅞ the snout-vent length.

Color. The dorsal color is gray or brownish slate, sometimes with a bluish tinge evident, especially laterally. In males there are small pink, orange, or yellow spots scattered profusely in the back, more prominent laterally but absent on the middorsal line. Occupying this median area are 2 rather closely placed series of small, dark brown, rounded spots about 11 in number, most distinct posteriorly; the anterior spots may be quite indistinct or absent. On each side, near the groin, are 2 diagonally placed, black or dark brown bars, separated from each other by a light area sometimes yellow or orange in color, and bordered on each side by the same color. The limbs have feebly defined dark crossbars or are uniform. On the tail the series of dorsal spots becomes larger, fuses near the base, and continues to the tip as a single series of undulate, transverse, dark bars; these bars are separated from each other by a distance greater than their own length; there are about 11 on the tail.

Below, the males are brilliantly colored, with the throat yellow or pink, suffused or heavily reticulated with a uniform slate gray. The chest may be suffused with a gray color, but otherwise it, as well as the middle of the belly and the limbs, are cream. The sides of the belly have a broad, pale blue patch



Pl. 23. *Holbrookia texana.* A–D, San Antonio, Texas; A, D, male; B, C, female. E, Helotes, Texas; male.

enclosing 2 broad, jet black, diagonal bands terminating dorsally as previously described. The ventral surface of the tail is white, with broad, black bands coinciding in position with the lighter brown dorsal bands.

Females are much less brilliantly colored both above and below than the

males. The sides are uniform, unmarked, and the dorsal spots may be rather small or even indistinguishable. There may be feeble indications of the lateral belly bars, but otherwise the belly is a uniform white or cream. The throat is marked as in males but lacks the bright colors in the light areas. The tail is barred below as in males.

Scalation. See Figs. 36 and 41. The supralabial scales are strongly keeled, placed diagonally instead of vertically, and project laterally rather prominently. The lower jaw is flat and fits flush with the edge of the outshelving upper jaw. The dorsal head scales are small; there are a few slightly enlarged supraoculars. The dorsal surfaces of the remainder of the animal are covered by very minute, overlapping scales. The throat scales are small and bordered posteriorly by several loose folds terminating with a transverse band of tiny, granular scales. The belly scales are larger than others on the body, flat; a few on shoulders are pointed, a little larger, and slightly projecting. There are from 10 to 19 femoral pores on each leg, average 13.4 in females, 14.4 in males.

Recognition Characters. The lack of ear openings and the black bars under the tail identify this species. Frequently confused with it are the various members of the genus *Callisaurus* which amazingly resemble the giant earless lizard. Those "mimics," however, have conspicuous ear openings.

Habitat. These lizards occur rather abundantly on rocky desert flats and in low hills. They are more or less restricted to rocky areas.

Habits. One of the most conspicuous habits of this lizard is to curl the tail over the back as it runs, revealing the black ventral bars. They do this most frequently two or three times as they are slowing to a stop and again just after. Another well-known habit is that of climbing to the tops of boulders, which serve as vantage points; in such places they frequently keep the tail constantly curled over the back. They tend to run from rock to rock, not stopping on flat ground.

They are fast runners and rather wary; with some care, however, it is easily possible to approach closely enough to shoot them with dust shot. They may also be chased under rocks or other objects and then caught by turning the cover and grabbing quickly for whatever may be underneath.

"When resting they stand with the front legs stiffly before them and slightly spread. They have the familiar habit of quickly and jerkily raising and lowering their bodies. When pursued this beautifully colored lizard never seeks cover but relies on speed entirely" (Ortenburger, pp. 105–106, *Ariz.*).

The eggs are 8 to 12 in number and are deposited in hard ground at a depth of 5 or 6 inches.

Problems. The most conspicuous problem concerning this species is its life history, which is peculiarly unknown in view of the abundance and conspicuousness of these lizards in many areas.

References. Schmidt, 1922, pp. 712–714, figs. 1, 2 (*gen. lit.*); Van Denburgh, 1922, pp. 177–180 (*gen. lit.*).

The Gridiron-tailed Lizards

Genus *CALLISAURUS* Blainville

Ten forms are known of this genus, all members of a single species with the possible exception of *splendidus*. All are found in southwestern United States, Baja California, Sonora, and Sinaloa.

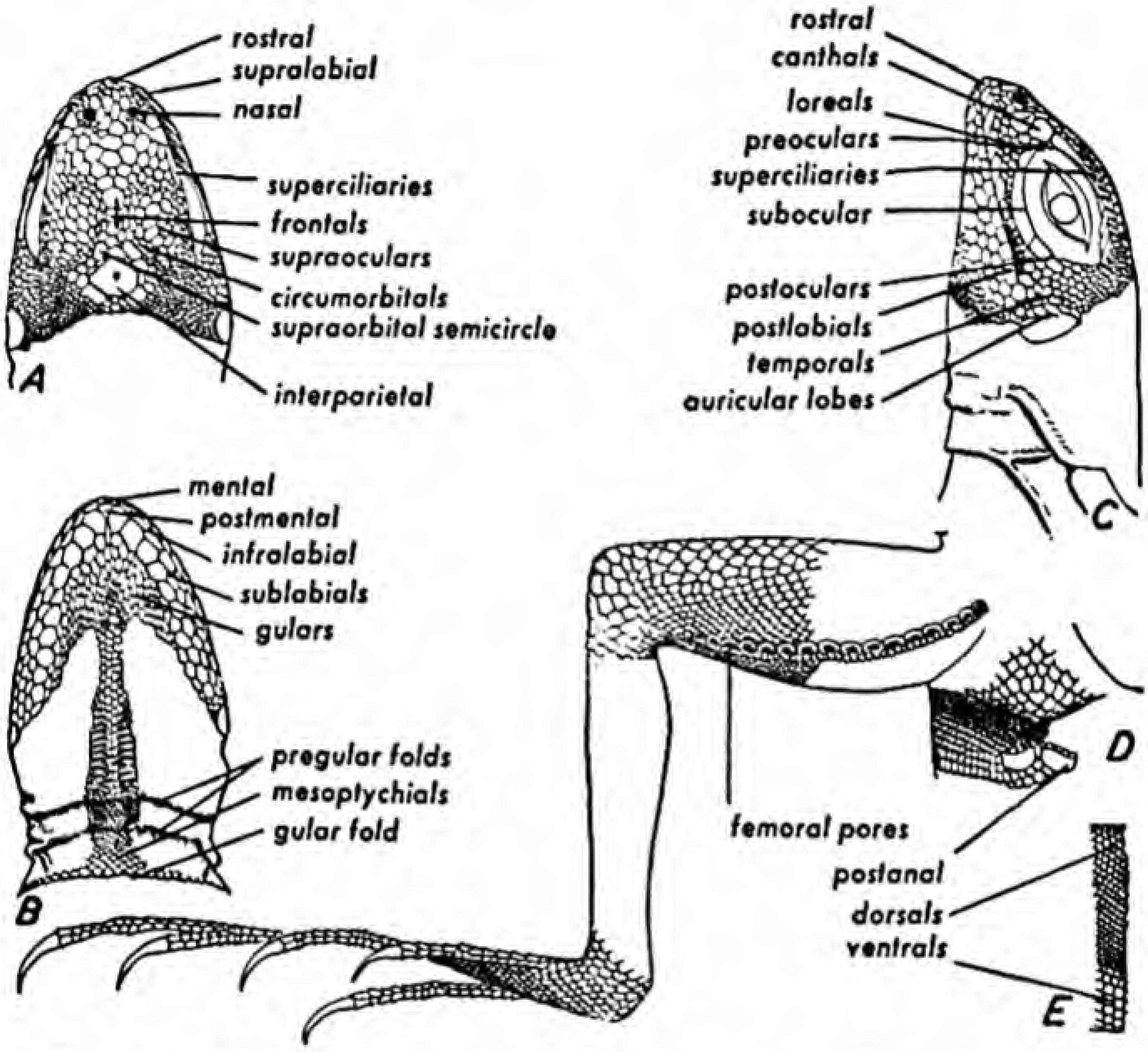


FIG. 65. Typical scutellation in *Callisaurus*, from *C. draconoides gabbii*, Mojave Desert, California. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

This is a genus characterized by negative characters. It has not lost the ear opening as has *Holbrookia* and has not developed prominent fringes on the toes as has *Uma*. Only by these two characters are the species of the genus distinguished readily from some of those of the other genera; except for them probably all the species would be placed in one genus. Some details of the scutellation of a typical race are shown in Fig. 65.

KEY TO SPECIES OF *CALLISAURUS*

1. Femoral pores generally (about 70 per cent or more) 16 or less 2
   Femoral pores generally 17 or more; supraorbital semicircles usually

not separated completely from interparietal scale; hind leg generally 91 per cent of body length, or less; tail generally 56 per cent of total length, or less .... *draconoides ventralis* (p. 146)

2. Tail generally 58 per cent or more of total length; hind leg generally 92 per cent of body length, or more .... *draconoides gabbii* (p. 138)

Tail generally 57 per cent or less of total length; hind leg generally 91 per cent or less of body length .... *draconoides myurus* (p. 145)

Common Gridiron-tailed Lizard *Callisaurus draconoides gabbii* Cope

(Fig. 43, p. 89; Fig. 65; Pl. 24)

Range. Southeastern California, southern Nevada, and western Arizona, south through the northern third of Baja California (excluding the northwestern coast) and extreme northwestern Sonora. Type locality—northern Baja California. (Map 6, p. 488.)

Size. The greatest recorded snout-vent length is about 93 mm. ($3^{11}/_{16}$ in.) in males. Females are a little shorter, probably seldom exceeding 75 mm. (3 in.) snout to vent. The tail is from 55 per cent to 65 per cent of the total length (average 59 per cent), and the hind legs are elongate, from 85 per cent to 101 per cent of the snout-vent length (average 93 per cent).

Color. Dorsal surface pale gray to gray-brown, speckled with slightly paler to distinct yellow dots. A series of rather small dark spots on either side of middorsal line, extending from the neck to the base of the tail, the spots becoming larger posteriorly; in some specimens these spots may scarcely be evident. Limbs with dim, dark crossbands. Tail with several broad, dark crossbands, separated from each other by light areas of about equal width. The anterior tail bands have irregular margins, since they appear to be formed by the fusion of the two series of dark spots extending posteriorly from the body. The remainder of the tail bands, however, have straight margins. The head is cream in life. A distinct black line present on posterior surface of thigh, bordered above and below by white.

The throat is dusky in a large, posterior, central area, and into this area enters a number of radiating black lines extending posteriorly from the labial region. The dusky central area is more prominent in males than in females. The tail is marked below with 4 to 8 black crossbands, most of which join the dorsal bands laterally.

In males there is a sky-blue to navy-blue patch on each side of the belly, enclosing 2 diagonal, jet-black marks that become brown on the sides of the body and disappear posterior to the axillae. In very large males the black bars are dimly discernible in the very extensive, dark blue patches, which may extend from axilla to groin. The chest, middle of belly, and ventral surfaces of the limbs are white.

Females are marked like the males below, except that they lack the blue

belly patches, and the dark bars on the sides of the belly are only faintly indicated.

The young show the dark dorsal spots rather clearly; in adults the spots tend to disappear. Juvenile males also lack very distinct lateral belly markings.

Pl. 24. *Callisaurus draconoides gabbii.* A, 23 miles east of Palmdale, California; male. B, 12 miles east of Palmdale, California. U.S. Fish and Wildlife Service photographs.

During the breeding season the males develop a conspicuous patch of metallic greenish blue on the sides of the body, and the light areas of the throat become pink. The latter color is displayed at this time by inflating the throat fan.

Dark and light color phases occur in this as in many other lizards. The former is correlated with moderate temperatures (between 68° F. and

100° F.), and the latter is correlated with high temperatures (over 100° F.). But the gridiron-tailed lizard is provided with another peculiar ability, and that is of again assuming the light phase at temperatures lower than about 68° F. It is a reaction not seen in any other member of the iguanids, at least of the series tested by Atsatt.

Scalation. See Fig. 65. Dorsal scales very small, smooth, a little larger medially; lateral scales somewhat smaller, except in a median area; ventral scales much larger than dorsals, grading into laterals, all smooth, flat. Dorsal head scales small; numerous slightly enlarged supraoculars; a row of enlarged scales in a supraorbital semicircle, the median 2 or 3 scales fused with the corresponding scales of the opposite series; interparietal about the size of the ear opening, generally completely separated from the supraorbital semicircles by a row of small scales; a large subocular; supralabials large, flaring, keeled, diagonal; mental very reduced, smaller than infralabials nearest it. A granular fold, preceded by slightly enlarged scales, across gular region. Femoral pores 11 to 20, average between 15.5 and 15.9. Enlarged postanals present in males.

Recognition Characters. Holbrookia texana resembles this species very closely, but the former can be distinguished, of course, by the absence of an ear opening. *Uma* also resembles *Callisaurus* but can readily be distinguished by the fringe on the fourth toe and the denticles on the anterior margin of the ear opening. The three races of *Callisaurus* in the United States can be distinguished with difficulty, however, and only by careful scrutiny and measurement of series of several specimens.

In tabular form the differences between the races are as follows:

	Tail, % of Total Length	Hind Leg, % of Body Length	Femoral Pores	Interparietal and Supraorbital Semicircles
gabbii	58 or more	92 or more	16 or less	Usually separated completely
ventralis	56 or less	91 or less	17 or more	Usually not " "
myurus	57 or less	91 or less	16 or less	———

Since each of the three races occupies its range to the exclusion of the other races, most specimens can be identified by locality alone if it is not desirable to make the measurements and counts necessary to check the identification, or if only one or two specimens are available. The comparisons listed above are based on averages, so it may be impossible to identify correctly single specimens, or even small series, without reference to locality.

Habitat. This exceedingly timid species is restricted to loose, sandy, or fine, gravelly soil in semiarid regions. At the edge of the Santa Catalina Mountains, Arizona, Ortenburger found large numbers of the eastern race, and collected 72 specimens, of which "38 were found on the sandy washes at the

mouths of the canyons; 11 in the cholla association west of the Cañada del Oro; 11 in the mesquite association of the plains; 6 in the willow-poplar association along the margin of the Cañada del Oro; and 6 a short distance (in no case over $\frac{3}{4}$ of a mile) up the canyons on the sand among the boulders." The habitats of the other races of the gridiron-tailed lizards are very similar, and their preferences are similar. In generally unsuitable rocky areas the species, if present, is confined to sandy washes and arroyos. Richardson observed that in the Pyramid Lake region the northern race, the most abundant reptile of the region, was most common on the sandy desert floor among low shrubs, and that it did not occur in dense growths of sagebrush nor on rocky hillsides. In northern Baja California beaches form a very desirable habitat, and about Mission San Fernando "wherever the red-flowered tarbidillo grows is a likely place to find the gridiron-tail lizard" (Tevis). Though more or less open areas are preferred, they are as a rule most common where small, scattered boulders occur, which are utilized as perches to aid observation. They may use other supports at times for the same purpose; Gloyd records observing one in the top of a dead cholla. Perches as high as 6 feet from the ground may be used.

Habits. Ordinarily strictly diurnal in habit, it is occasionally found abroad at night. Whether the nocturnal activity may be normal or is caused simply by some unusual disturbance after the lizards have burrowed under the sand to rest is not known; presumably the latter is the case. During the day, in the height of the season, they are active from early morning until about 10:00 A.M., and again, to a lesser degree, from late afternoon until dark. In early spring they are active during midday. At cool localities or on cool days the lizards adapt themselves to the conditions by later emergence and earlier retirement. In central Baja California at Miller's Landing on the Pacific coast, where fog and cool breezes from the ocean "were a chilling contrast to the hot, clear climate of the Gulf," Tevis reported:

> On June 17 when the fog did not break until 8:30 A.M., the first lizard [2] was seen at 9:05 A.M. Not until 11:00 A.M. were the lizards out in full numbers, and even then in order to escape the ocean breezes they concentrated on the inland side of the dunes. None foraged on the beach. The lizards were further localized in their distribution, being restricted to the ridges, where the sand, fifteen minutes after the fog broke, was too hot for me to walk on with bare feet. In the depressions, where the sand was cooler at first, the lizards were rarely found.

Obviously these lizards avoid either very low or very high temperatures. Body temperatures of 117° F. or over always result in death; lethal temperatures were reached experimentally by an exposure of 9 minutes to a combined air temperature of 92° F. and a soil temperature of 138° F.

On their observation perches the lizards show great alertness, raising and

[2] Notes based upon *C. d. carmenensis*, a form closely resembling *C. d. gabbii*.

lowering themselves by extending and flexing the forelegs (this is not just to avoid absorption of heat from the rock, for the soles of the feet are more sensitive to the heat than the belly) and bobbing their heads; the small throat fan may be spread if other specimens are about (in the breeding season); and the tail may be curled forward over the back, exposing the white ventral surface with its black bars, and waved slowly from side to side. The latter reaction is one that usually occurs in alarm, or after the lizards have run a short distance and stopped. If they are still farther pursued, they dart off again in a flash, generally leaving the watcher's eye glued to the spot where the conspicuous black bars had been waving a moment before. Tevis, however, states that the lizards carry the tail curled over the back even when running. "On being stalked, a lizard shows nervousness by wagging its tail from side to side flat on the sand, then increasing the tempo until the tail is lifted and curled over the back, and away goes the lizard at top speed. Once the tail starts wagging, the collector might as well shoot; the lizard is sure to run. Probably this tail wagging functions to direct a predator's initial attention to the tail." The dorsal pattern blends so perfectly with the surroundings that the lizards can be seen only with great difficulty unless the underside of the tail is exposed. "Sometimes, if I did not walk directly toward a lizard, it allowed a 3-foot approach, so much did it depend on protective coloration. But if it realized it had been seen, there was no stopping the rush to cover. A lizard once stalked so that it knows itself the object of the hunt is exceedingly wary and intolerant of approach" (Tevis). From high perches the lizards can detect a human intruder within 100 feet, and, if approached, they waste no time in fleeing.

Numerous authors have commented upon the great speed of these lizards. When traveling across the line of sight they are almost impossible to follow. Klauber thinks they are probably the fastest on the desert. Camp estimated the speed of one specimen to be about 90 feet in 4 seconds, or about 15 miles an hour. This is about 5 times as fast as the fastest snakes, but less than the speed a man can muster (100 yards in 9.4 seconds, or 21.7 miles an hour). In running the lizards do not proceed in a straight line but describe an arc to the right or left. When pursued and unable to find cover, they run in circles, eventually tiring and permitting themselves to be picked up. In the presence of broken brush or boulders a fleeing lizard "typically describes a zig-zag course with right-angle turns executed only when on the opposite side of a large rock or bush" (Tevis). They start and stop running with extraordinary and confusing abruptness and generally are good for at least 50 feet when startled. Upon stopping they have been described as placing their forelegs stiffly forward and sliding "a few inches amid a scattering of sand and pebbles." Sometimes they stop just before taking refuge in a bush, and at other times they first place a bush between themselves and the observer before stopping to reconnoiter. "Although by depressing the tail the lizard appears to

melt into the substratum, it can be found again, unless wounded, if the point at which it stopped is noted. A wounded lizard invariably disappears, presumably by burying itself in the sand" (Tevis). These lizards will enter mammal holes when closely pressed, or dive under the surface of the sand. Toward sunset they burrow under the sand, from where they may be startled almost underfoot as one walks along. Richardson records that "during a light thunder shower many of these lizards buried themselves in the loose desert sand, where they remained until almost trodden on before showing themselves."

Observations recorded by Tevis on northern specimens of *C. d. carmenensis* from Bahia de los Angeles, on the Gulf coast of Baja California, are of considerable interest as an indication of probable habits of other similar races, like *C. d. gabbii* and *C. d. ventralis*. At that locality

a colony on a 100-foot wide 400-yard long sand spit projecting into the bay was restricted to the outer third, the only part of the spit on which grew thickets of salt bush. Tidal wrack on the surrounding beach attracted these lizards, many of whom foraged over the beach up to 45 feet from cover and to within 5 feet of the water's edge. But at the slightest disturbance, such as my approach 150 feet or more distant, the beach was astir with a phalanx of lizards racing back to the salt bush. Where a 4-foot vertical wall of hard-packed sand bordered the beach the lizards went up and over it by sheer force of momentum. One lizard failed on its first try. Then, starting from the base instead of distantly, it tried six times in rapid succession, but each time fell back. After this it rested for fifteen seconds, tried again more calmly, got a hind foot grip on a protruding clam shell, gained the top, and dashed to the brush. The return to the beach by each lizard was cautious, a short rush followed by about four minutes of watching and then another rush.

While foraging on the beach the lizards often jabbed at the sand with their mouths, probably to seize one of the many small insects and crustaceans, or made a 6-inch rush in pursuit of some animal. When not actively foraging, the lizards climbed onto the fish and ray carcasses, gastropod shells, clam shells, turtle carapaces, and pieces of iron that littered the beach and there sunned and watched and sometimes bobbed up and down.

Each individual had an attachment for a particular object. One lizard that I watched for about half an hour ran from the salt bush 25 feet directly to the carcass of a ray and for the remaining time until disturbed by me either squatted on the ray or foraged within 6 inches of it. Occasionally by using the front feet it dug half-inch deep pits at the end of the carcass in order to get at the beetles feeding on the under side. The top of the carcass was utilized for basking. No other lizard came within 10 feet.

I estimated that each individual had a fairly small range along the axis of the beach, about 50 feet; but in spite of intolerance of one lizard for another there was much overlapping of ranges. In the chases observed it was always a large lizard that pursued a smaller one.

Because the lizards on the sand spit were warier and harder to shoot than those on the mainland I had to resort to two techniques to obtain specimens:

1. To crash through the brush until a lizard was stirred up. A lizard under cover, in contrast to one in the open, is not likely to run far and therefore can be shot when its position under the brush is determined.

2. To walk along the beach close to the brush. Most of the lizards will run to cover, but a few, particularly those that are far from cover, will stay motionless, relying on their protective coloration. If the collector appreciates this fact, he can spend any amount of time desired studying the beach until the form of a lizard is segregated from the substratum. When the lizard crouches on a mat of dark tidal wrack, as it often does, it can be detected easily. The lizards do not appreciate the fact that their protective coloration succeeds only when applied against the sand.

The general light-gray of the dorsum almost perfectly duplicates the light-gray sand, but a few individuals, always found under brush, were conspicuous because they were darkly colored.[3] Various naturalists, among them Schmidt (1922: Plate 21, figs. 2 and 3) have pointed out that the gridiron-tailed lizard has dark and light color phases, and experimental work by Atsatt (1939) demonstrated that they are dark until the temperature rises to 40° C. (104° F.), after which the light phase develops. It is likely that the dark lizards I noted were dark because they had not yet ventured into the hot sunlight; and, although the presumed function of the light phase is to prevent extra absorption of heat, at Bahia de los Angeles it also acted to increase the lizard's resemblance to the substratum.

At Miller's Landing [on the Pacific Coast] the situation was reversed. There the fog and ocean breezes were a chilling contrast to the hot, clear climate of the Gulf, the massive dunes were dark-gray instead of light-gray, and, with few exceptions, the dorsal color of the lizards was dark-gray. The exceptions in the light-color phase were strikingly conspicuous. If the predominance of the dark color phase at Miller's Landing is attributable only to temperature, the lizard's resemblance to the dark-gray sand was a coincidence resulting from the cooling effect of the ocean, as at Bahia de los Angeles the resemblance to the light-gray sand would be a coincidence resulting from the hot climate of the Gulf.

The food consists largely of insects, of which a large proportion are active types. Spiders also are taken. Leaves and blossoms are sometimes eaten—apparently predominantly in the spring and early summer. Camp records that

these lizards sometimes spring a foot or more to seize a tempting bait; and I saw one, probably by mistake, leap over the edge of an eight-foot wash-bank while jumping for a grasshopper in a bush. At Blythe Junction a gridiron-tailed lizard was seen regularly at a certain doorstep picking up dead crane-flies and other night-flying insects thrown there by the housewife. The lizard apparently became so absorbed in picking up, shaking and swallowing the gauzy-winged flies that it many times permitted the observer to touch it lightly on the back.

Klauber once observed a specimen chasing a uta at high speed, but they twisted out of sight before the result could be seen. Whether the *Callisaurus* was after food is a matter of conjecture. Skin fragments found in one stomach

[3] Cf. p. 43 for explanation of a comparable phenomenon in *Anolis*.

indicate that these lizards, like the anoles, may eat their skins as they are shed.

The breeding habits are not well known. A part of the mating behavior seems to be the use of the throat fan, which at other times of the year is not inflated. Specimens containing large eggs, from 2 to 6 in number, have been observed as late as August (Ruthven, Tucson) and eggs are laid as early as July 7 (Bogert, Los Angeles County). The eggs measure 18 to 22 mm. x 9 to 11 mm. at the time they are about ready to be laid.

Nematodes have been found in the stomach on several occasions.

Richardson records that a wounded specimen uttered a high-pitched cry when handled.

Problems. The whole group of *Callisaurus* of western United States is in need of revision. The subspecies are not adequately characterized, nor are their ranges well worked out. There is very little information on the life history.

References. Atsatt, 1939, pp. 250–253, fig. 5, color change (*lit. cit.*); Bogert, 1930, pp. 6–7 (*Calif.*); Gloyd, 1937, pp. 98, 107, habits, Arizona records (*Ariz.*); Klauber, 1939, pp. 33, 55, 65, 66, 68, 69, 71, 73, 74, 75, 82, 83, 87, 88, table 15, habits (*Ariz.*); Knowlton and Smith, 1935, pp. 102–103, food, eggs (*lit. cit.*); Knowlton and Thomas, 1934, p. 257, food (*lit. cit.*); Linsdale, 1932, pp. 357–359, taxonomy (*lit. cit.*); *idem*, 1940, pp. 220–221, fig. 11, map, Nevada localities (*Nev.*); MacCoy, 1932, pp. 15–16, habits (*Ariz.*); Mosauer, 1936, pp. 62, 65, heat resistance (*lit. cit.*); Ortenburger, 1926, p. 105, habits (*Ariz.*); Pack, 1923, pp. 79–82, food (*lit. cit.*); Richardson, 1915, pp. 408–412, taxonomy, habits (*Nev.*); Ruthven, 1907, pp. 518–523, color, habitat, food (*Ariz.*); Schmidt, 1922, pp. 646–651, taxonomy (*lit. cit.*); Tevis, 1944, pp. 7–12, fig. 1, map, habits, taxonomy (*lit. cit.*); Van Denburgh, 1922, pp. 152–168, pls. 12–13, description, taxonomy, habits (*gen. lit.*).

Northern Gridiron-tailed Lizard *Callisaurus draconoides myurus* Richardson

(Pl. 25)

Range. Western Nevada, from central Washoe to central Mineral County in the Pyramid and Walker Lake region. Type locality—Pyramid Lake Indian Agency, Nevada. (Map 6, p. 488.)

Size. As in other subspecies of *draconoides,* reaching a maximum at about 86 mm. ($3\frac{3}{8}$ in.) snout to vent. The tail is 54 per cent to 58 per cent (average 55 per cent) of the total length.

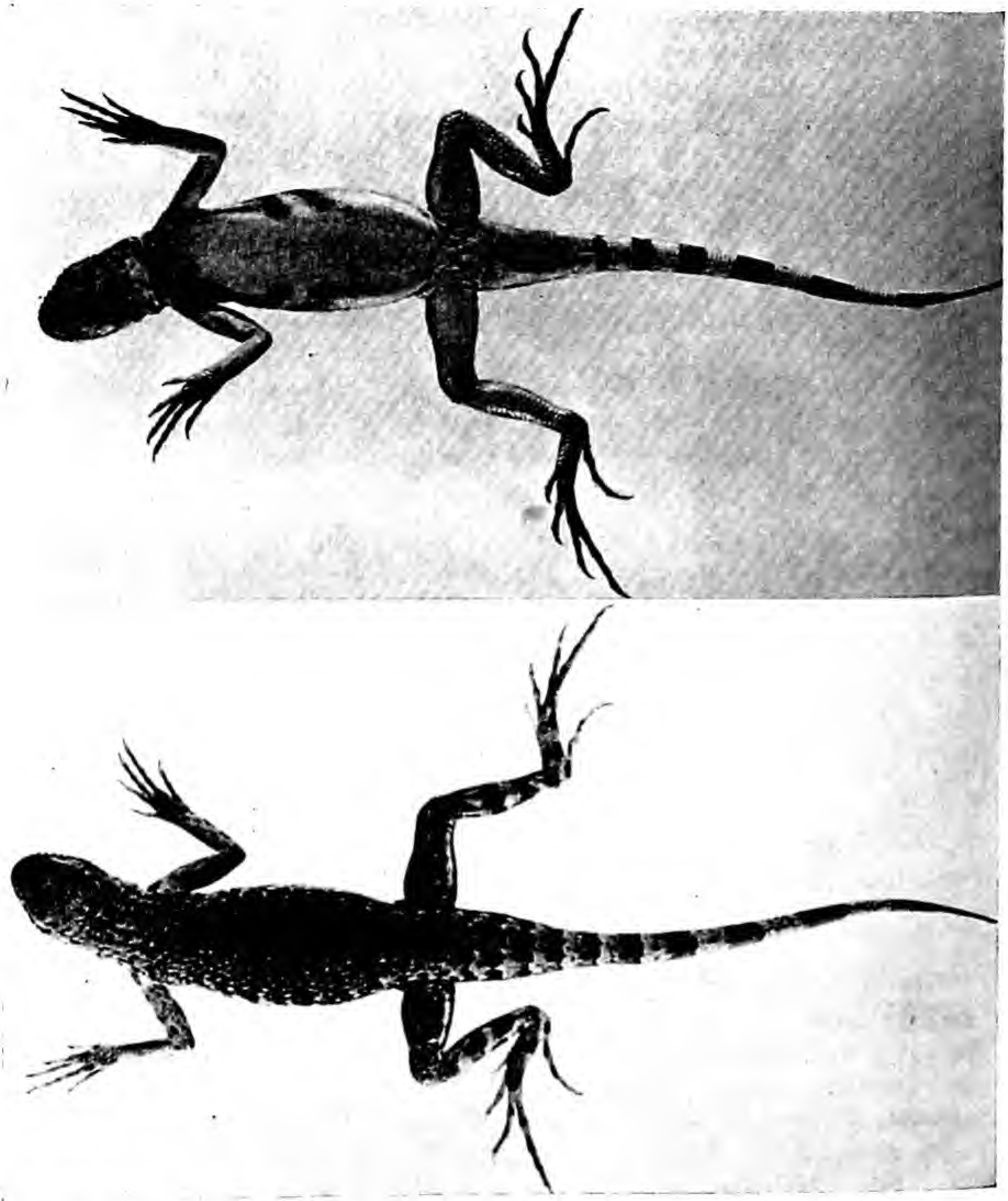
Color. As in *d. gabbii,* except that the dorsal spots remain a little more prominent throughout life, and the general dorsal tone is darker.

Scalation. As in *d. gabbii* (Fig. 65) except that the femoral pores vary from 11 to 16, averaging 13.6.

Recognition Characters. See discussion of *d. gabbii.*

Habits and Habitat. See *d. gabbii.*

References. See *d. gabbii.*



Pl. 25. *Callisaurus draconoides myurus.* Pyramid Lake, Nevada; female. U.S. Fish and Wildlife Service photographs.

Eastern Gridiron-tailed Lizard *Callisaurus draconoides ventralis* (Hallowell)

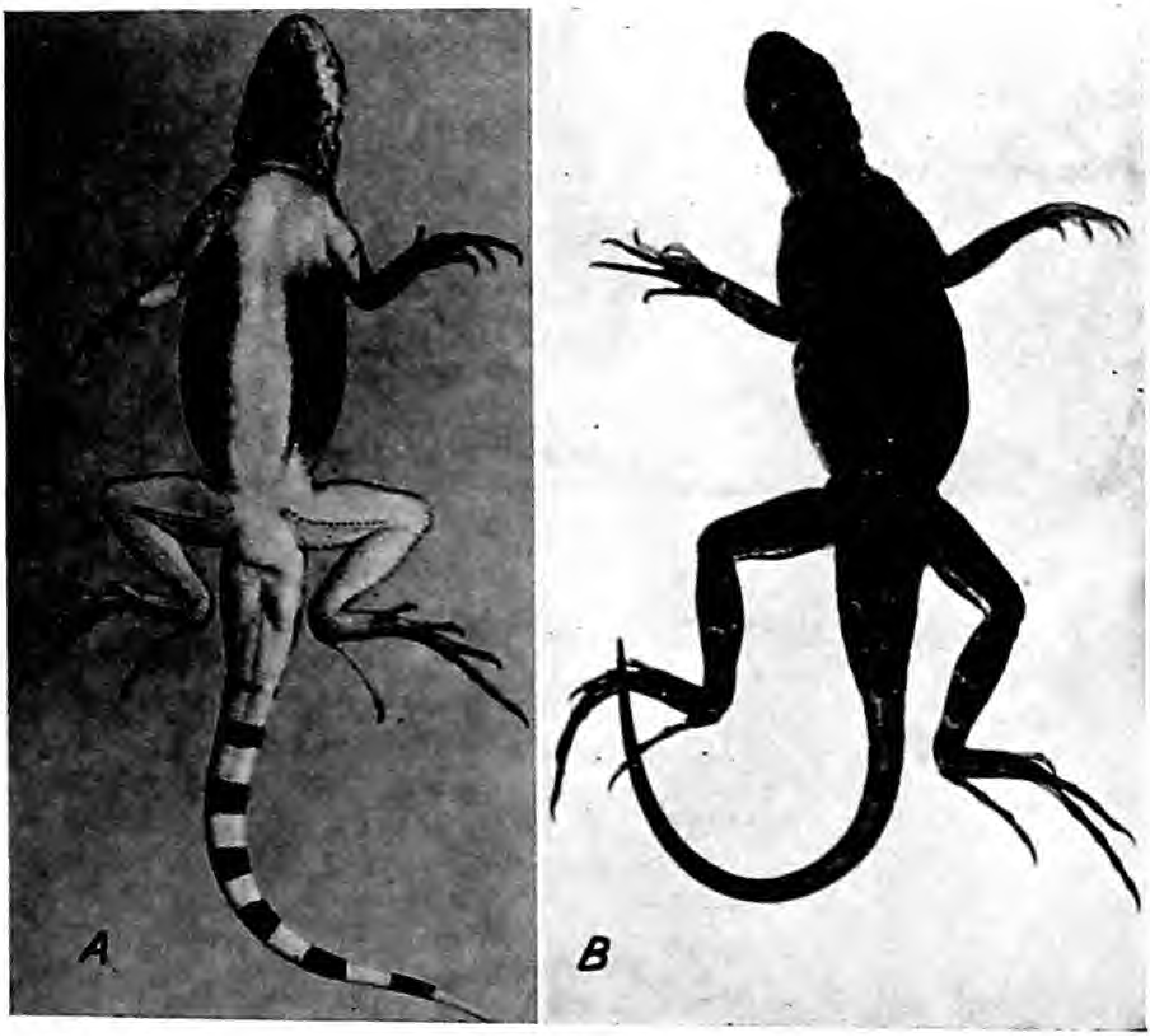
(Pl. 26)

Range. Central southern Arizona, southward in Sonora about to Guaymas. Type locality—"New Mexico west of Rio Grande" (Arizona). (Map 6, p. 488.)

Size. About the same as that of other subspecies of *draconoides,* reaching a

maximum at about 85 mm. ($3\frac{3}{8}$ in.) snout to vent. The tail is from 51 per cent to 56 per cent (average 54 per cent) of the total length, and the hind leg is from 78 per cent to 95 per cent (average 86 per cent) of the snout-vent length.

Color. As in *d. gabbii.*



Pl. 26. *Callisaurus draconoides ventralis.* A. Tucson Mountains, Arizona; male. B, 10 miles east of Safford, Arizona; female.

Scalation. As in *d. gabbii* (Fig. 65) except that the interparietal plate is usually in contact with the supraorbital semicircles, and the femoral pores vary from 14 to 23, averaging about 17.5.

Recognition Characters. See discussion of *d. gabbii.*

Habits and Habitat. Since these are about the same for all races of the species, all notes are included under the discussion of the common gridiron-tailed lizard; they can apply to any of the three races.

References. See *d. gabbii.*

The Umas

Genus *UMA* Baird

This genus is composed of some four forms, all but one of which occurs in the United States. One extralimital form occurs in Sonora, Mexico. No other genus of the country is so well adapted—in an active fashion—to sand life. The wedge-shaped snout, with its countersunk jaw; the thick, serrated eye-

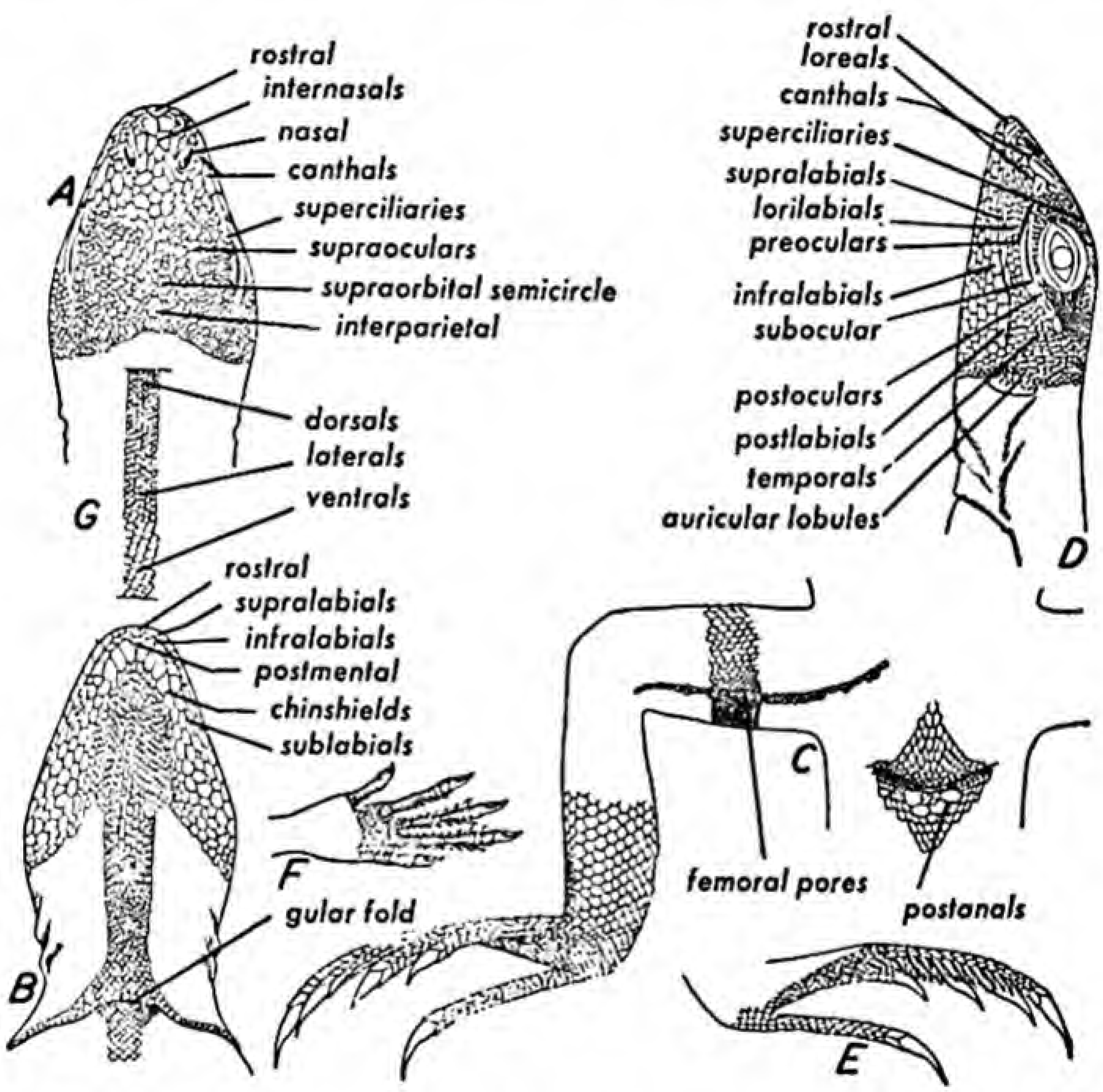


FIG. 66. Typical scutellation in *Uma,* from *Uma scoparia,* "Tucson, Arizona." A, top of head; B, underside of head; C, ventral view of right hind leg and anal region; D, side of head; E, dorsal view of right hind foot; F, dorsal view of right hand; G, section of body in side view. From Cope.

lids; the scale fringes along the toes of the fore and hind feet; the depressed, broad, body form; the velvety, finely granular scalation; and the peculiar nasal passages—all seem to be definite adaptations to an arenaceous habit.

Some authors have united this genus with *Callisaurus,* but a number of characters—the small interparietal, the large scales protecting the ear, the dermal ear valve, the great development of fringes (Fig. 42, p. 89), etc.—dis-

tinguish it from the gridiron-tailed lizards. Some details of the scutellation of a typical species are shown in Fig. 66 and in Fig. 42.

KEY TO SPECIES OF *UMA*

1. No black blotches on sides of belly; convergent lines on throat disappearing toward middle of throat; usually 3 internasals (as in Fig. 67); femoral pores usually fewer than 29; dorsal ocelli arranged in linear series .... *inornata* (p. 149)
   A pair of black blotches on sides of belly 2

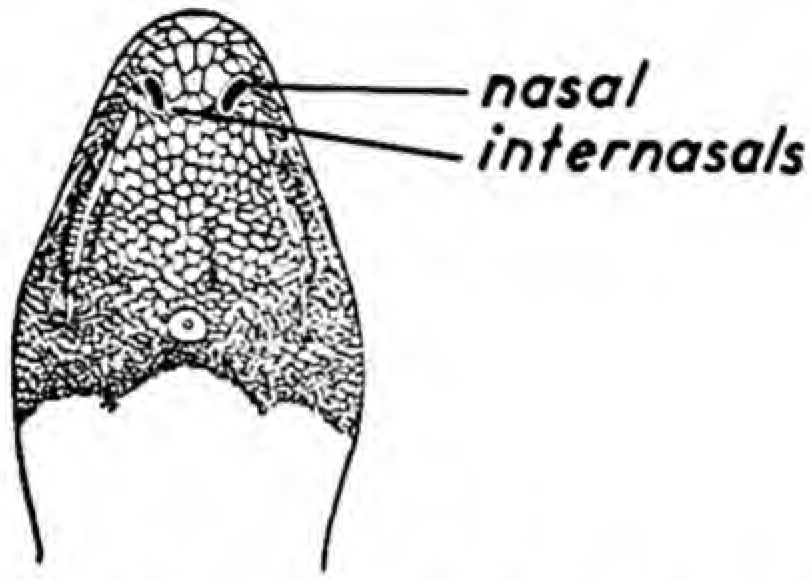


Fig. 67. *Uma n. notata*, top of head. From Cope.

2. Convergent lines on throat expanded toward middle of throat, forming conspicuous, black crescents; internasals usually 5; femoral pores usually over 29; dorsal ocelli scattered .... *scoparia* (p. 156)
   No gular crescents, lines disappearing toward middle of throat; internasals usually 3; femoral pores usually fewer than 29; dorsal ocelli arranged in linear series .... *notata notata* (p. 154)

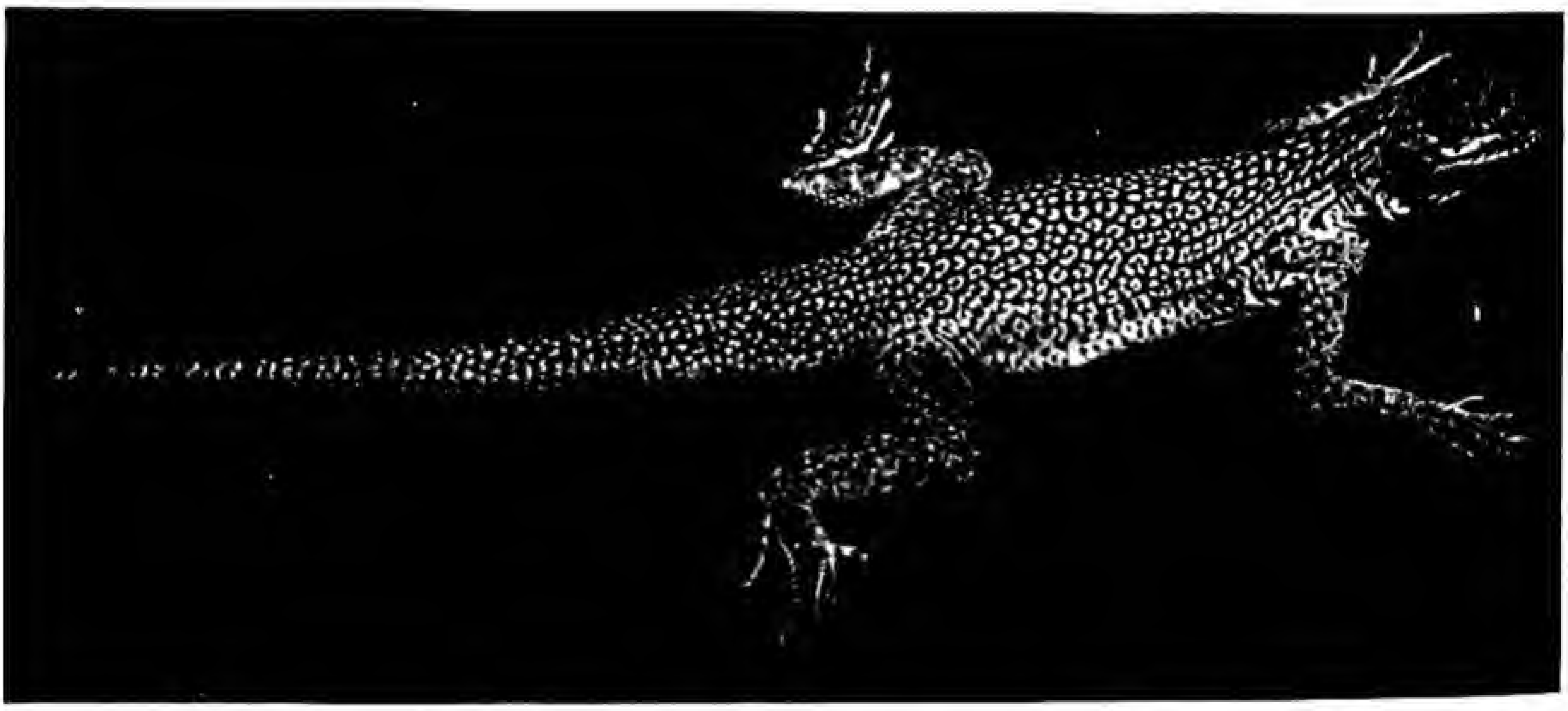
Coachella Uma *Uma inornata* Cope
(Pl. 27)

Range. Coachella Valley, central Riverside County, California, from Whitewater to Indian Wells. Type locality—"Colorado Desert, San Diego County, California" (in error, doubtless Riverside County). (Map 5, p. 487.)

Size. Moderately large, reaching a maximum snout-vent measurement at about 115 mm. (4½ in.). The tail is broad and flat, very slightly less to slightly more than the snout-vent length, varying from 49 per cent to 64 per cent of the total length.

Color. A striking pattern occurs, with reticulating black lines on the back outlining more or less regular, rounded ocelli of the light gray or white ground color. The ocelli tend to be arranged in longitudinal rows, especially anteriorly, where the ocelli of each series may partly fuse with each other,

producing a series of irregular, parallel, black lines. The ocelli, especially posteriorly, tend to have a small, central, black spot. The black network breaks up on the sides of the body and on the limbs, where small black spots are scattered on a gray background. The markings break up, but to a lesser degree, on the tail also. The head has a finer reticulation of black, not forming distinct ocelli.



Pl. 27. *Uma inornata.* Edom, Riverside County, California; male.

On the lower surface of the head several narrow black lines converge toward the central posterior part of the throat, there becoming fainter and narrower, and disappearing. Three to ten black crossbands are present on the subcaudal surface, the anterior ones considerably narrower than others. Otherwise the ventral surface is white.

Scalation. Similar in most respects to that shown in Fig. 66. Dorsal and lateral scales very small, smooth, convex, about equal; ventral scales larger, smooth, flat. Dorsal head scales smooth, small; supraoculars small; supraorbital semicircles poorly defined; 3 rows of scales (as in Fig. 67) between nares, which are large, elongate, dorsal in position; supralabials flaring, keeled, diagonal; a large canthal and a large subocular; mental very reduced. Ear opening twice as large as interparietal plate, but partly concealed by an anterior flap of skin bearing a number of elongate scales. Scales on anterior surface of forearm protruding somewhat. A peculiar patch of enlarged scales on posterior surface of thighs. A conspicuous fringe of elongate scales (25 to 36) on the lateral margin of the fourth toe and a less conspicuous fringe on the third toe. A granular gular fold, preceded by somewhat enlarged scales; central throat scales slightly enlarged. Subcaudal scales larger than dorsal caudals but smaller than belly scales. Enlarged postanals present in males. Femoral pores are 18 to 28 on each side, average 23.

Recognition Characters. The fringe on the fourth toe is the most characteristic feature of the umas, although there are several other features that are

unusual. From its United States relatives, *inornata* can easily be distinguished by the absence of a black spot on either side of the abdomen. It also lacks broad black lines across the posterior part of the throat, and has only 3 rows of internasals.

Habitat. These interesting lizards are adapted to life in areas of loose sand, and they do not occur elsewhere. They are most abundant on dunes, but occur also on level or undulating sand where very low vegetation is more or less abundant. There is no other reptile in the United States that shows an actual preference for the dunes.

Habits. In view of the many adaptations to sand life,

it is not surprising to find that the Ocellated Sand-Lizard is the only reptile which shows a decided preference for the mighty barren dunes. Specimens can be seen at any time of the day on top of the dunes near the edges. Frequently they are found buried in the sand, only the head partly or fully exposed, and then they are not discovered until they rush for safety almost from under foot. Often they are buried in loose sand, but just as often they leave behind them a small blind burrow with oval, depressed mouth, just large enough to accommodate their flattened bodies. During the hotter time of the day these lizards are extremely wary. Apparently they have an especially keen eyesight and turn to flight when the intruder is still a hundred or more feet away. Thus one does not see much of them during a ramble over the dunes at midday except for their tracks. These are seen everywhere on the tops of the dunes, mostly closely paralleling the edges where the lizards seem to spend a good deal of their time. When disturbed, they dash over the edge and run or skid down the loose sand of the steep lee side into the shelter of the *Atriplex* bushes that grow at the foot of the dune, or into the burrows of Kangaroo Rats which offer welcome refuge to most reptiles. In spite of their apparently plump and rather heavy build the speed of these lizards is considerable (Mosauer).

Other authors have noted that in spite of the toe fringes the speed attained is not so great as that of some other desert lizards, as for instance *Cnemidophorus* and *Callisaurus*. Cowles has suggested that the fringes of the feet are not so much adaptations for speed as they are for "facilitating the subsurface swimming motion, an important factor in adjustment to deep burial. The fringes fold down along the toes as these are drawn forward through the sand, while on the backward thrust the structures are elevated by and against the pressure of the sand." Sand swimming is the usual resort for a retreat from enemies and deleterious temperatures. Rodent burrows and other excavations are often used also. "Most fossorial activity appears to be limited to movements not over several times the total length of the animal. Sand-swimming is accomplished by lateral movements of the head and fore parts, accompanied by propulsive movements of the hind feet. The forelimbs are not employed in submergence but lie appressed to the sides. The action of the hind foot and fringes is valvular" (Stebbins).

It appears that the front legs are of little use in swift running and are used mainly for balance. The tracks appear to be made largely, if not entirely, by the hind legs, except when movement is slow; they are 5 to 6 inches apart. The lizards run on their toes and fingers, not on their soles and palms.

"Hearing has been clearly established for Uma. The lizards not only detect sounds such as whistled notes, snapping of fingers, and talking but also, even when buried, those produced by the movements of insect prey on the surface of the sand" (Stebbins).

Researches by Stebbins prove that the pineal eye is visually functionless. The eyelids are peculiarly adapted for the arenaceous habitat. Stebbins describes these lizards and some of their habits as follows:

> The free edges of the eyelids overlap, an arrangement which tends to prevent the incursion of sand particles during sand-swimming. The lids come together along an outer and an inner ridge, a chamber occurring between them. The double occlusion of the lids tends to prevent loss of water from the eye. If sand particles were to reach the moist inner contacting ridges, fluid would be removed from the orbital region by capillary action. Perception of changes in light intensity may be possible through a translucent area in the lower eyelid.
>
> Sand which reaches the eye surface either by wind action or through sand-swimming, accumulates in the anterior eye corner. This sand becomes encapsulated in mucous and is expelled by the action of the nictitating membrane.

As Klauber describes,

> There are various ways of catching *Uma notata* alive. Usually, when frightened, this lizard will run for a short distance and dive into the sand, especially after placing a bush between himself and the hunter. Go to the other side of the bush and look for a patch of lizard hide, or a protruding tail, for sometimes they bury themselves carelessly. If this fails, use the fingers as a rake, but be ready to grab if you strike something, or the prey will be off again like a flash. Be careful that what you grab isn't a sidewinder. Sometimes in going after a single specimen in the sand below a bush, 3 or 4 whose presence has never been suspected will emerge.
>
> A scheme for scaring up these lizards, when they are not running freely on the dunes, is to make use of a stick held flat against the dune surface, brushing rapidly across the sand at a depth of about an inch or more. In this way a considerable area can be disturbed with little effort. The shade of bushes, if any be present, is likely to be particularly fruitful, for these lizards seek shade when they burrow.
>
> An interesting variant is to find a bush at the top of a dune. Rake the sand with a stick. As the lizards emerge from the sand they will run up the slope, on which the sand is at its natural angle of repose. As they run up dig some sand away at the bottom, whereupon the sand of the entire surface of the slope will start cascading downward, flowing faster than the lizards can run or swim up, thus bringing them within reach.
>
> When a *Uma* buries itself by swimming below the sand surface, he ends by trembling his tail, like a harmless snake in anger. This usually completes his concealment.

Sand-lizards will perch on rocks for observation if there be any about. They will also climb up in bushes for the same purpose. They bob their heads in the manner characteristic of so many lizards. If not sure from what direction danger threatens, they will sometimes run in a small circle, stopping near the starting point.

According to Stebbins,

The color of the lizards approximates that of the sand upon which they dwell. Cast shadow is frequently concealed by lying close to the ground. Spots and streaks in the eye region, arranged essentially in a linear series, tend to mask the eye in most individuals. The eye pattern is particularly effective when the lizards lie among the intricate shadow of bushes.

Though these lizards can be seen actively running about the dunes during the hottest parts of the summers and on the hottest parts of the day, they are killed by exactly the same temperatures as many other reptiles, even nocturnal types. Body temperatures of about 114° F. are fatal. Since the sand temperature is hotter than this during much of the day, obviously the lizards do not subject themselves to exposure to such heat over a very long period. They dash from shade to shade, or burrow a few inches under the surface of the sand, where the temperatures are considerably lower. When specimens are experimentally exposed to sand temperatures of 114° to 120° F. and not allowed to burrow or seek shade, although otherwise given complete freedom of movement, death results after an hour or so, at which time the body temperature has reached the sand temperature. Discomfort is registered much earlier, in 10 or 15 minutes. When the sand is hotter, about 140° F., death occurs in a very short time—in about 10 minutes. Optimum body temperatures average about 101° F., while the minimum voluntarily tolerated temperature is about 79° F., the maximum 104° F.

Cowles found one of these lizards hibernating in the sand at a depth of about 12 inches below the surface, where it was a little over 50° F. At this temperature the lizards are torpid and incapable of well co-ordinated movement. It is very possible that in spring they are more deeply interred (see below). Cowles believes that during winter probably "at least the juveniles of this lizard, like some of the smaller species in the same area, do not pass into complete torpidity but respond to the fluctuating temperatures characteristic of desert areas. Large adults, however, assume a state of complete hibernation." Young specimens were observed as early as February 24, and under favorable conditions were seen occasionally after that date, before continuous warm weather began.

Throughout this period all were exceedingly wary, usually taking refuge in rodent burrows although a few attempted to bury themselves in the damp, hard-packed sand. The condition of the sand apparently determines, in part at least, the mode of escape, although it was noticed at later dates that the small specimens usually show some preference for rodent burrows whereas the larger individuals usually attempt to escape through resorting to the sand-swimming technique.

As late as November 20 gradually diminishing numbers of *Uma* are available during favorable weather. Night temperatures as low as 0° C. (32° F.), provided they are not too prolonged and are counterbalanced by high diurnal temperatures, do not appear to produce hibernation in the entire population, although adults appear to become scarcer with the progress of the season. As late as November 20 good collecting may be obtained by raking the sand away from the leeward faces of the sand dunes and smaller hummocks, especially around the bases of bushes and shrubs. Occasionally by this procedure an adult may be unearthed.

On November 20 a juvenile was taken from 1 inch below the surface of the sand, at a temperature of 15° C. (60° F.). Two subadults were taken at the same place at depths of 4 and 6 inches, body temperatures 18° C. (65° F.). Both were torpid, but were capable of slow progression by irregular, poorly coördinated movements.

It is noteworthy that both in spring and in the fall, with only very rare exceptions, the animals were located on a leeward slope, most frequently among the stems of protruding bushes, or from the lower third of a bare dune face. It is obvious that this habit insures them against excavation by the prevailing winds and sandstorms, although it must also mean that unless some protective response is at work and the animals are capable of movement, they must be buried to a depth of several feet by the time of spring emergence.

Eggs are laid, but the number laid and the nature of the site are not known. A dissected female contained 3 eggs, each 9 mm. in diameter; another contained 1 egg 18 mm. in diameter (cf. Camp, p. 516, *Calif.*).

The food consists mostly of insects, but also includes succulent plant parts. Tenebrionid beetles form an important part of the diet, at least at times. Sight is a major factor in locating food, but hearing and smell may also be employed. Nematodes have been found in the stomach.

References. Cowles, 1941, pp. 125, 129–130, pl. 3, hibernation (*lit. cit.*); Heifetz, 1941, pp. 99–111, taxonomy (*gen. lit.*); Klauber, 1939, pp. 33, 35, 65, 68, 70, 75, 83, 86–87, table 15, habits (*Ariz.*); Mosauer, 1932, pp. 73, 75, fig. 1, snout adaptation (*lit. cit.*); *idem,* 1935, pp. 17–18, 25, 26, habitat, habits (*Calif.*); *idem,* 1936, pp. 56, 60–61, 65, heat resistance (*lit. cit.*); Stebbins, 1943, pp. 38–52, figs. 1–2, pls. 1–2, adaptations of nasal passages (*lit. cit.*); *idem,* 1944, pp. 311–332 (*lit. cit.*); Van Denburgh, 1922, pp. 132–138, pls. 10, 11, description, habits, literature summary (*gen. lit.*).

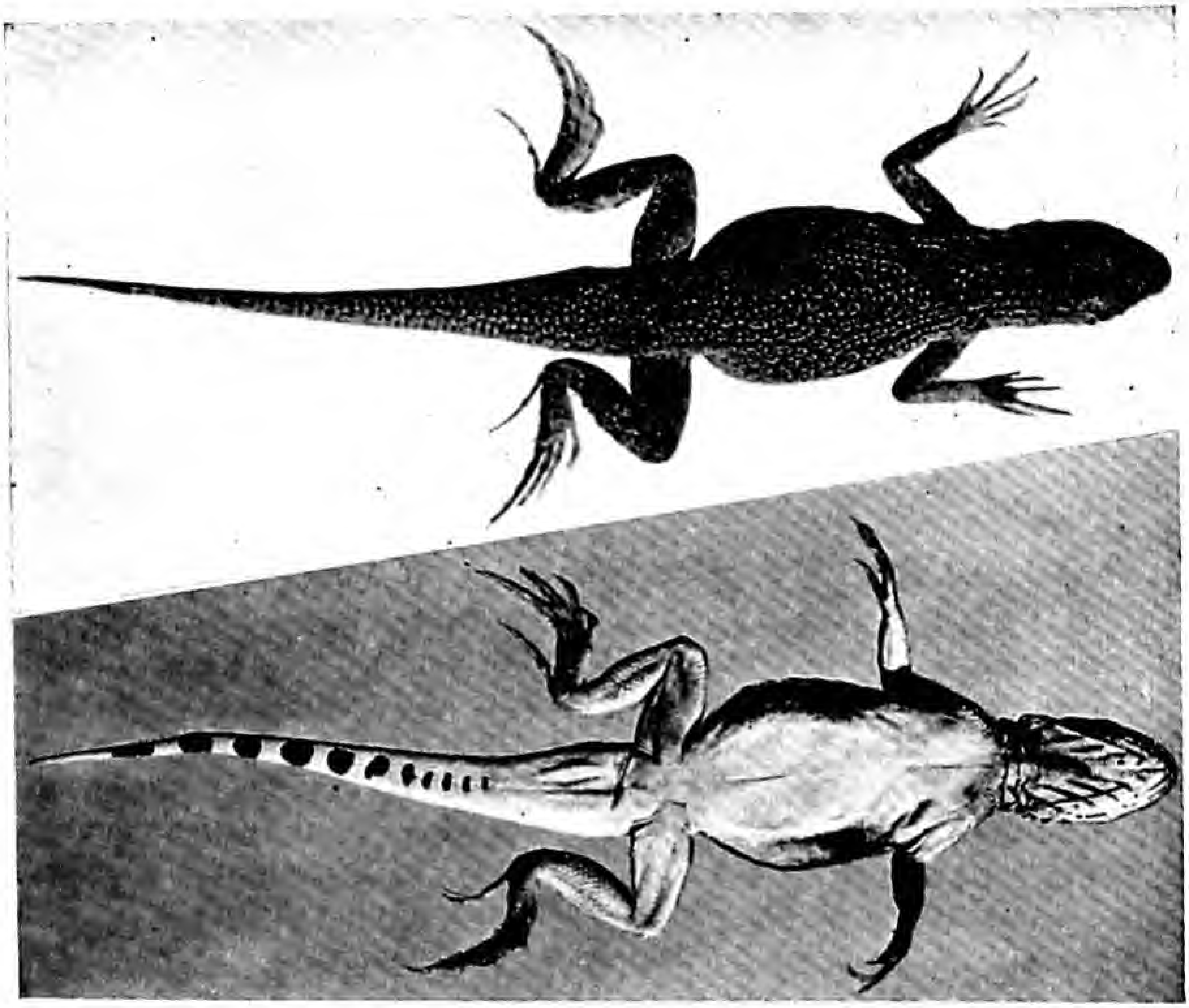
Colorado Uma *Uma notata notata* Baird

(Fig. 42, p. 89; Fig. 67, p. 149; Pl. 28)

Range. Extreme southeastern California west to extreme eastern San Diego County, southwestern Arizona near Yuma, and northeastern Baja California. Type locality—"Mojave Desert" (in error; doubtless Colorado Desert, California). (Map 5, p. 487.)

Size. Maximum about 105 mm. ($4\frac{1}{2}$ in.) snout to vent, as in *inornata.*

Color. As in *inornata* except for the following differences: usually the dorsal, black network edged with reddish brown; the tail more spotted, the ocelli less distinct on it; head markings dimmer; a conspicuous, more or less rounded, black spot on either side of abdomen, about halfway between axilla and groin. This mark is about half the size of the preanal area.



Pl. 28. *Uma notata notata.* Colorado Desert, California; female.

Scalation. See Fig. 67 and compare with Fig. 66. As in *inornata,* except the femoral pores number 20 to 31, averaging 25, and the fringe spines on fourth toe 25 to 40, averaging 30.

Recognition Characters. The presence of a lateral abdominal black mark and the absence of broad dark lines across the posterior part of the throat separate specimens of this species from others of the genus in the United States. Also distinctive are three rows of internasals and a femoral pore count of usually less than 26.

Habits and Habitat. As described for the Coachella uma.

References. See *Uma inornata.*

Crescent Uma *Uma scoparia* Cope

(Fig. 66, p. 148; Pl. 29)

Range. "The Mojave Desert of California, from eastern Riverside County, north to Kelso in San Bernardino County, and west to northeastern Los Angeles County" (Heifetz). Type locality—"Fort Buchanan, Arizona" (in error; probably San Bernardino County, California). (Map 5, p. 487.)

Size. As in others of the genus, reaching a maximum at about 105 mm. ($4\frac{1}{2}$ in.) snout to vent.

Color. Dorsal pattern much as in *inornata* except that the black network is reduced greatly and does not form continuous longitudinal lines. A black, lateral, belly spot is present as in *n. notata*. One, or usually 2, of the dark diagonal lines on the ventral surface of the head enter the central posterior gular region and join the line on the opposite side; the distinctive feature of this is not so much the union of the lines, which may rarely occur in other species of *Uma*, as their broadening and their greater distinctness in the central gular area. Two enlarged black spots are usually present on the sides anterior to the insertion of the thigh, and a pair of black preanal spots is often present.

Scalation. See Fig. 66. As in *inornata*, except femoral pores 22 to 47, average 31; fringe spines 28 to 40, average 34; 5 rows of internasals.

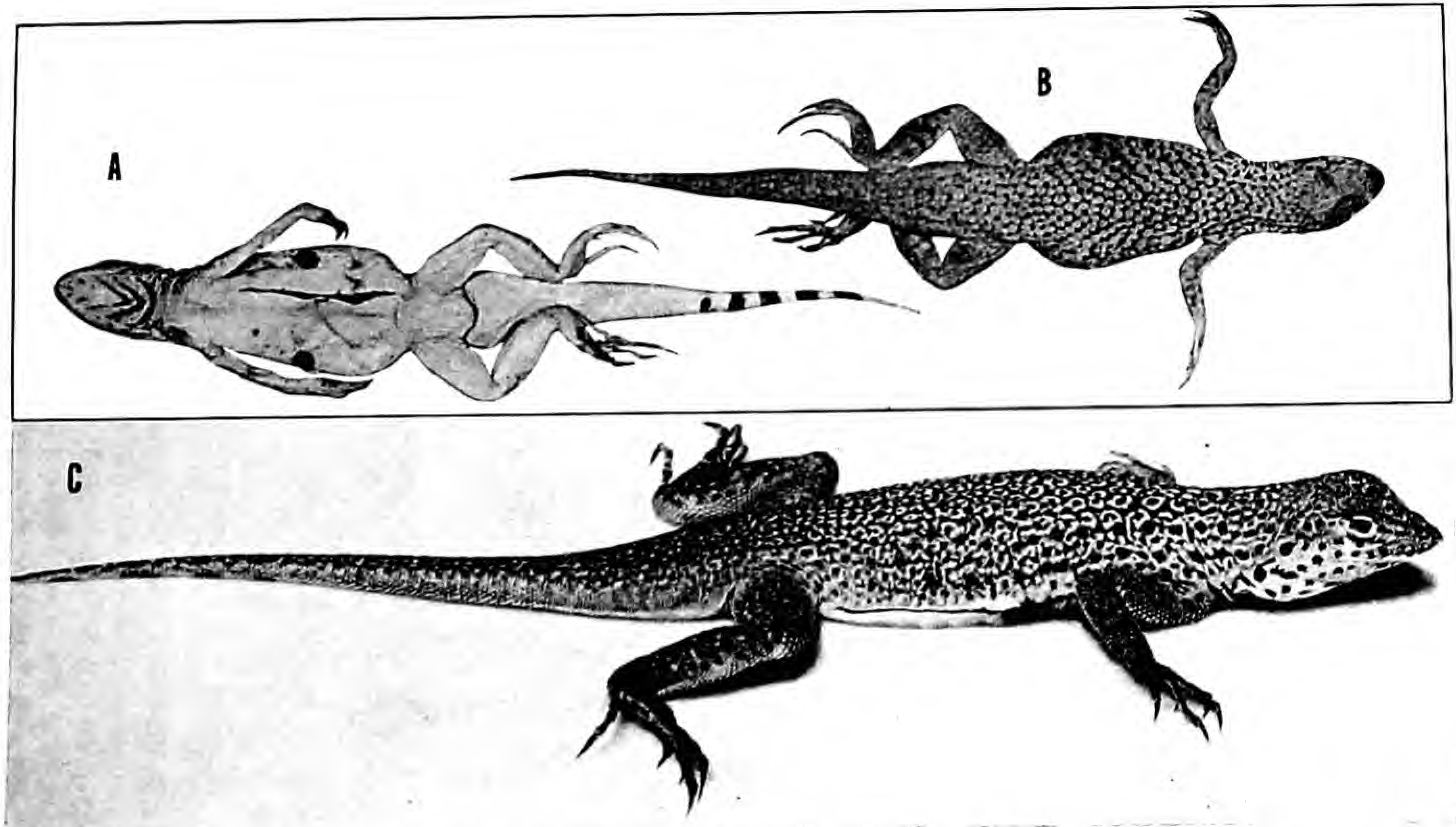
Recognition Characters. The two distinctive features of this species, compared with others of the genus, are the presence of black gular crescents in the central posterior gular region and the presence of 5 instead of 3 rows of internasals. Also diagnostic are the numerous femoral pores, usually 29 or more (they are usually 28 or less in the related *n. notata*), and the more numerous spines in the fringe on the fourth toe, usually 33 or more (usually 32 or less in *n. notata*).

Habits and Habitat. As described for the Coachella uma.

References. See *Uma inornata.*

The Rock-Lizard Section

Three genera of this group occur in the United States: *Gambelia, Crotaphytus*, and *Streptosaurus*. *Petrosaurus*, very similar to the last, is a Baja California genus. The first I assume to be the more primitive because of its thicker, somewhat quadrangular head. *Crotaphytus* is obviously similar but has developed a flattened head and an extraordinarily constricted neck. *Streptosaurus* is widely different from these two, but in body form, size, and tail scalation it finds a closer parallel in these genera than in the members of *Uta* and *Urosaurus*. This parallelism is assumed here to indicate true relationship; it could conceivably be misleading.



Pl. 29. *Uma scoparia*. Blythe Junction, California. A, B, Maas photographs; C, courtesy of J. R. Slevin.

The Leopard Lizards

Genus *GAMBELIA* Baird

Only two forms comprise this genus, which is very similar to *Crotaphytus.* The chief differences between the two are in (1) the shape of the head (very narrow in *Gambelia,* broad in *Crotaphytus*), (2) the size of the rostral and mental (respectively 4 and 3 times as broad as adjacent labials in *Gambelia;* about 2 times as broad as labials in *Crotaphytus*), (3) the number of scales bordering the mental posteriorly between the infralabials (3 or more, gen-

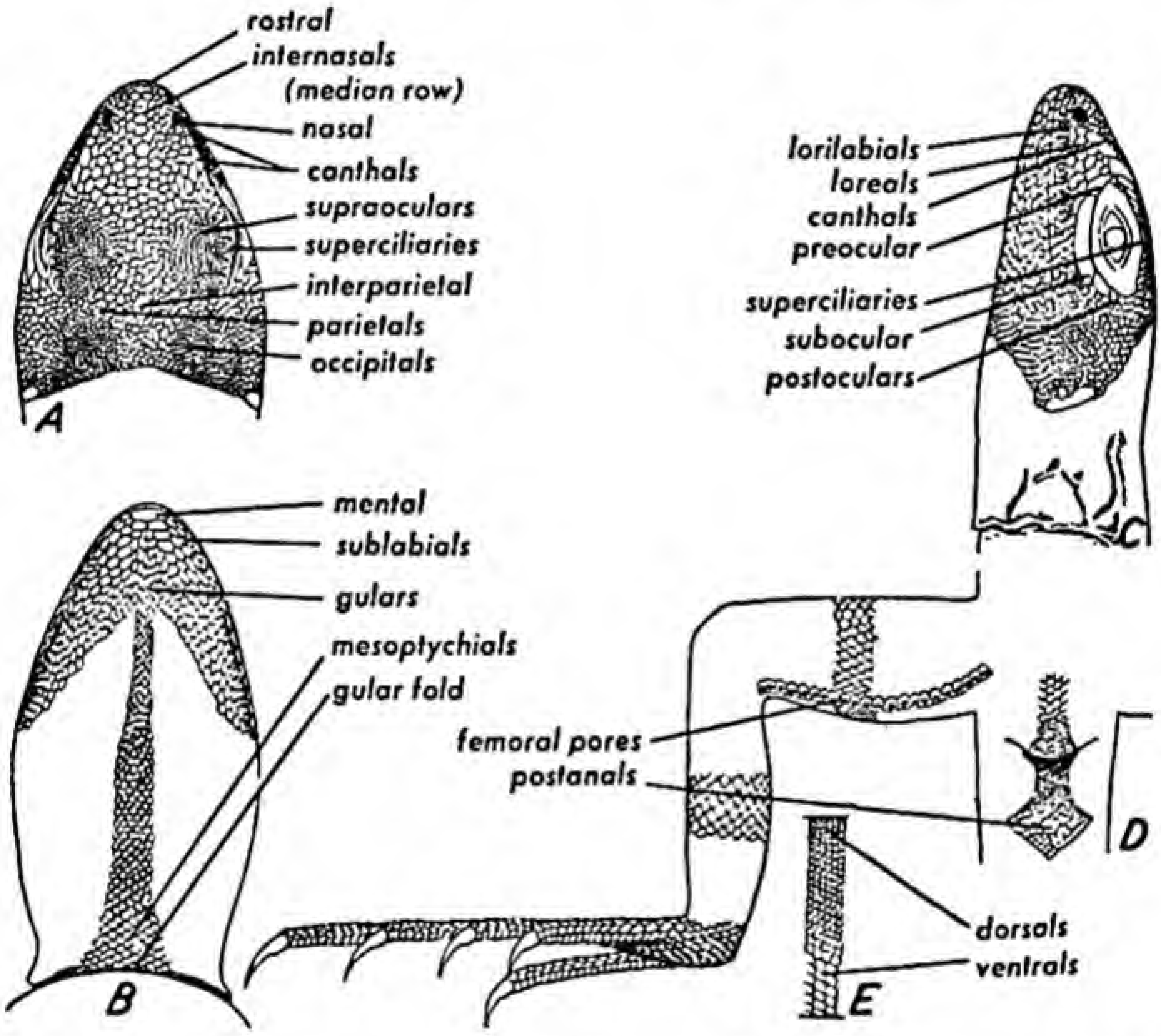


FIG. 68. Typical scutellation in *Gambelia,* from *G. w. wislizenii,* San Bernardino, California. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

erally 4, in *Gambelia,* 2 in *Crotaphytus*), (4) the number of pregular folds (none in *Gambelia,* one in *Crotaphytus,* less well defined than the gular fold but visible and modified structurally), (5) the number of suboculars (one in *Gambelia,* several in *Crotaphytus,* usually), (6) the general character of dorsal head scales (small, nearly uniform in *Gambelia,* larger, with distinct supraorbital semicircles and supraoculars, in *Crotaphytus,* (7) the size of the caudal scales (very small in *Gambelia,* as are body scales), (8) the character

of the scales bordering the ventral lamellae on the outer surface of the fourth toe (forming a feeble fringe in *Gambelia* but not in *Crotaphytus*), (9) the character of the internasals (a median row of enlarged scales in *Gambelia*, irregular and the median scales frequently smaller in *Crotaphytus*), and (10) the egg complement (up to 24 in *Crotaphytus*, only 2 to 4 in *Gambelia*). The type species of *Gambelia* is *Crotaphytus wislizenii* Baird and Girard. Some features of its scutellation are shown in Fig. 68.

In general appearance *Gambelia* with its narrow, elongate head is well distinguished from *Crotaphytus* with its almost grotesquely enlarged head and slender neck.

The name *Gambelia* first appeared in 1859, in Baird's "Reptiles of the Boundary" (p. 7, *lit. cit.*), by casual mention in the discussion of *Crotaphytus reticulatus*, as follows: "More closely related to *Crotaphytus collaris* than to *Crotaphytus* (*Gambelia*) *wislizenii*." The name has been overlooked apparently by all subsequent catalogers.

The two forms of the genus are very closely related and distinguishable only with some difficulty.

KEY TO SPECIES OF *GAMBELIA*

1. Greatest width of head about equal to distance from nostril to anterior border of ear; only in San Joaquin Valley and eastern San Luis Obispo County, California .... *wislizenii silus* (p. 164)
   Greatest width of head greater than distance from nostril to anterior border of ear; not in San Joaquin Valley ...... *wislizenii wislizenii* (p. 159)

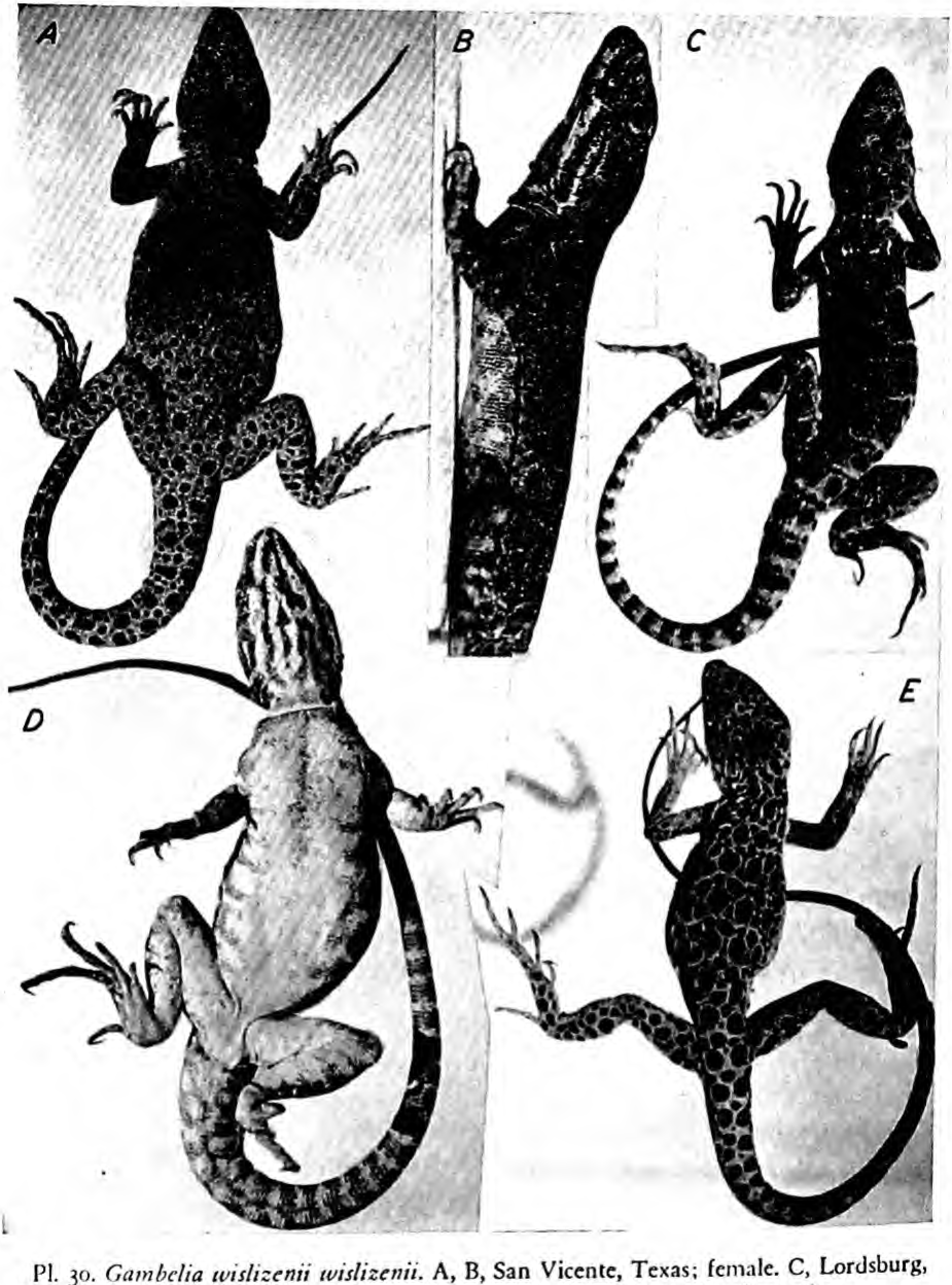
Common Leopard Lizard *Gambelia wislizenii wislizenii* (Baird and Girard)

(Fig. 57, p. 91; Fig. 68; Pl. 30)

Range. Central Idaho and eastern Oregon southward through western Colorado and western Texas on the east and through the eastern desert regions of California on the west, reaching the Pacific slopes in Riverside and San Diego counties; southward to central Chihuahua, central Sonora, the southern tip of Baja California, and western Coahuila in Mexico. Type locality—Sante Fe, New Mexico. (Map 7, p. 489.)

Size. The largest recorded specimen measures 119 mm. ($4\frac{3}{4}$ in.) snout to vent. The tail is somewhat more than twice the head-body measurement except in the young, in which it may be a little shorter.

Color. Very variable. The ground color is light gray or gray-brown, generally largely obscured by numerous markings; in rare specimens, however, only a few small, dark spots break the uniformity of the dorsal color. Practically all specimens have 8 to 11 narrow, transverse, light lines on the sides, meeting or alternating with each other at the middorsal line. Scattered be-



Pl. 30. *Gambelia wislizenii wislizenii.* A, B, San Vicente, Texas; female. C, Lordsburg, New Mexico; young. D, San Vicente, Texas; female. E, Fernley, Nevada; male.

tween these are a number of rounded, dark brown spots, sometimes rather large and few in number, nearly touching both light lines, but more frequently small, numerous, and in 2 or 3 transverse series between each pair of light lines. The lines may be broken into sections that may be staggered anteriorly or posteriorly from the normal position. The dark spots, when large,

are very dark medially. Small dark spots may be present on the head, or no markings whatever. The limbs and tail are marked like the body, most distinctly on the tail, least distinctly on the forelegs. Certain light areas on the body are orange, others yellow.

The ventral surfaces are white, unmarked save on the skin and throat, where parallel, longitudinal, dark lines about 6 in number extend from the infralabials to the gular fold region. The ventral surface of the tail may be mottled with a dark color, and may be pink in the light areas.

The variation in pattern is due in part to temperature changes, as every individual may vary its pattern considerably during a single day. Dark or light phases may be assumed, or any intermediate phase.

> In its dark phase the entire upper surface is dark, with indistinct darker spots, and with distinct narrow light bands on dorsum and partial bands on head, legs and tail. On the ventral side the conspicuous dark lines on the throat merge into a gray suffusion on the chest, lessening posteriorly. In the light phase, the dorsal surface is light with conspicuous dark spots and inconspicuous light bands. In this phase the common name of "leopard lizard" is very appropriate. At the same time, the ventral side presents a glistening white except for a few brown spots in the faint streaks on the throat. . . . Experimentally, at high temperature it is in the light phase, irrespective of illumination; at low temperature, it becomes darker in the presence of illumination and becomes lighter when put in darkness (Atsatt).

Merriam (in Stejneger) noted long ago—and his observations have been well substantiated—

> In many lizards, as well known, the male assumes a special coloration during the breeding season. The present species is a notable exception, the male remaining the same, while the female undergoes a remarkable change. The whole under surface and sides of the tail become deep salmon or even salmon red, and the sides of the body assume the same color, either uniformly or in blotches. The red markings on the side usually begin as spots, which soon unite to form transverse stripes. The central part of the back is not affected by the change, and the dark markings on the sides remain distinct. None were seen in this condition until May 20. . . . The change does not take place till late in the development of the egg. Many pairs were observed in copulation . . . from May 11 to May 19, but no trace of the red coloration had appeared. The red individuals were always found to contain large eggs, generally measuring from 12 to 15 mm. in length, with the coriaceous shell already formed.

Scalation. See Fig. 68. Head scales small; no supraorbital semicircles; supraoculars very tiny, none enlarged; a short preocular, a long subocular reaching to below the middle of the eye, and 3 postoculars, all keeled; ear opening large, vertically oval; mental bordered by several small scales posteriorly. Dorsal scales very small, convex, but little larger on tail; ventral scales flat, smooth, much larger than dorsals. Enlarged postanals present in males. Femoral pores 14 to 25.

Recognition Characters. This species, and the short-nosed leopard lizard, can be distinguished from their nearest relatives by the narrower head, the absence of distinct supraorbital semicircles, the presence of an enlarged subocular, and by the presence of 3 to 5 scales bordering the mental posteriorly. In the territory in which they occur, the only similar species is the northern crested lizard, which is easily distinguished by the elevated, median row of enlarged dorsal scales. Comparisons of the two forms of leopard lizards are given in the discussion of the following subspecies.

Habitat. This is a species inhabiting desert areas where vegetation is sparse, the terrain flat, and the soil rather loose. It does not live on wandering sand dunes, nor in bouldered areas, but ranges to 7000 feet (Nevada). In Utah, near Fillmore, Stuart discovered that fine soils are preferred by the species; rocky soils are avoided. Linsdale (1938) observed that in Nevada "there was little uniformity in type of soil inhabited; sometimes it was hard alkali ground, sometimes on fine sand, and sometimes on rather coarse gravel. At all of these places scattered bushes or clumps of bushes provided shelter as well as feeding places for the insect prey of the lizards. Kind of bush made little difference so far as our work indicated preference." The feeble fringes on the toes perhaps reflect a preference for finer soils, as they seem useful in locomotion under such conditions. On the Jornada Experimental Range in New Mexico these lizards are common "especially in sand-hills of the plain." In northern Nevada Ruthven and Gaige found specimens in only one locality—on a low flat. Near Tucson, Ortenburger (1936, p. 104, *Ariz.*) says:

> In contrast to *C. collaris baileyi*, it was never found in the canyons but always in the mesquite or cholla association. Three of the five specimens were found among the *Acacia*, *Celtis*, and mesquite on the desert floor, while the other two were collected in quite a different habitat—the low cholla-covered ridges just west of the Cañada del Oro. All were shot after they had taken refuge under bushes. These lizards are there quite difficult to see, for to escape detection they usually flatten themselves on the ground where their brown spotted coloration blends with that of the ground surface.

In Arizona Gloyd (1937, pp. 98, 106, *Ariz.*) noted that "individuals were seldom seen more than a foot or two from the entrance of a burrow into which they usually would dash before one could approach within pistol range. Most of those secured were shot from the car."

Habits. This lizard was once stated to be "chiefly vegetarian" (Merriam, in Stejneger). No one has verified this. In fact, very extensive observations, particularly by Knowlton, have shown rather definitely that this is a carnivorous lizard. The food is predominantly grasshoppers, but other Orthoptera and occasional Homoptera, Hemiptera, Coleoptera, Diptera, larval Lepidoptera, Hymenoptera, and spiders are eaten. Small insects (i.e., leaf hoppers) are not eaten. Many authors have observed that other lizards are frequently eaten; this species is actually one of the most cannibalistic known in this

country. They eat specimens of their own species and *Uta stansburiana, Sceloporus graciosus, S. u. consobrinus, S. magister, Holbrookia maculata, Callisaurus draconoides, Cnemidophorus tesselatus,* and *Phrynosoma platyrhinos.* Richardson, in Nevada, described the activities of a specimen that "ran into a bush after a cicada which apparently it failed to secure. Next it crawled along slowly, occasionally protruding its tongue. When a fly buzzed about the bush and lit nearby the lizard crawled slowly toward it, and as the insect left the ground the lizard jumped four inches into the air after it. In the jump all four feet left the ground" (Quoted by Linsdale, 1940). Linsdale (1938) records that a specimen followed a grasshopper as it flew about 2 feet above the ground by running swiftly and directly below it. Franklin said he saw a specimen jump 2 feet into the air to catch a cicada.

In southern Baja California, Tevis reports:

> The leopard lizards from Medano Blanco were shot on the sandy, cactus-covered Plain of Magdalena. Because of the lack of brush cover there were no hiding places, and the lizards attempted to escape in a characteristic manner. Each ran 50 feet or farther to a spot behind a cactus, crouched there low against the ground, and became motionless, apparently expecting to elude detection thereby, for it then allowed approach to within 3 feet.
>
> The one from the sand dunes southeast of Venancio started up when I was 40 feet distant, ran 100 feet at great speed across the dunes, and disappeared into a low, spreading type of bush. Subsequent search revealed it crouching under cover as close as possible to the sand. I approached to within 3 feet of it in order to see if it would take alarm again. It did not.

This curious habit is not recorded in observations on United States specimens; it deserves special attention.

Richardson records that specimens hiss and vigorously attempt to bite when captured; he heard one utter a low moaning sound. Their viciousness has been noted by several authors.

The eggs number 2 to 4, are laid during the first half of July, and hatch in August. Ruthven and Stuart believe the hatching period is 35 days or more. Numerous authors have mentioned observing young specimens in August and September, but only large specimens during June and July. Mating has been observed as early as May 11 and as late as June 5. Parts of the mating behavior have been described by Linsdale (1938 and 1940).

Problems. The variation in pattern in this species is tremendous, and in all probability is correlated to some extent with geographic and physiographic areas. A careful study of this variation should yield very interesting results. Klauber has noted that the inland desert specimens are larger and lighter than coastal specimens.

References. Atsatt, 1939, pp. 248–249, color (*lit. cit.*); Franklin, 1914, pp. 1–2, habits (*lit. cit.*); Klauber, 1932, p. 121 (*Calif.*); Knowlton and Janes, 1934, pp. 10–11, food (*lit. cit.*); Linsdale, 1938, pp. 25–26, and 1940, pp. 215–218 (*Nev.*); Pack,

1922, pp. 1–4, food (*lit. cit.*); Richardson, 1915, pp. 407–408, eggs (*Nev.*); Ruthven and Gaige, 1915, pp. 16–17, habits, color (*Nev.*); Ruthven and Stuart, 1932, pp. 1, 2, hatching period (*lit. cit.*); Stejneger, 1893, p. 167 (*Calif.*); Taylor, 1912, pp. 346–348, habits, color (*Nev.*); Tevis, 1944, p. 7 (*lit. cit.*); Van Denburgh, 1922, pp. 116–128, pl. 8, description, habits, etc. (*gen. lit.*).

San Joaquin Leopard Lizard *Gambelia wislizenii silus* (Stejneger) (Pl. 31)

Range. San Joaquin Valley of central California and eastern San Luis Obispo County, California. Type locality—Fresno, California. (Map 7, p. 489.)

Size. Rather large, strong-legged lizards measuring up to about 115 mm. (4½ in.) in head-body length. The tail is long, round in cross section, about twice as long as the body or somewhat less. The hind legs are notably stouter than the forelegs and about twice as long.

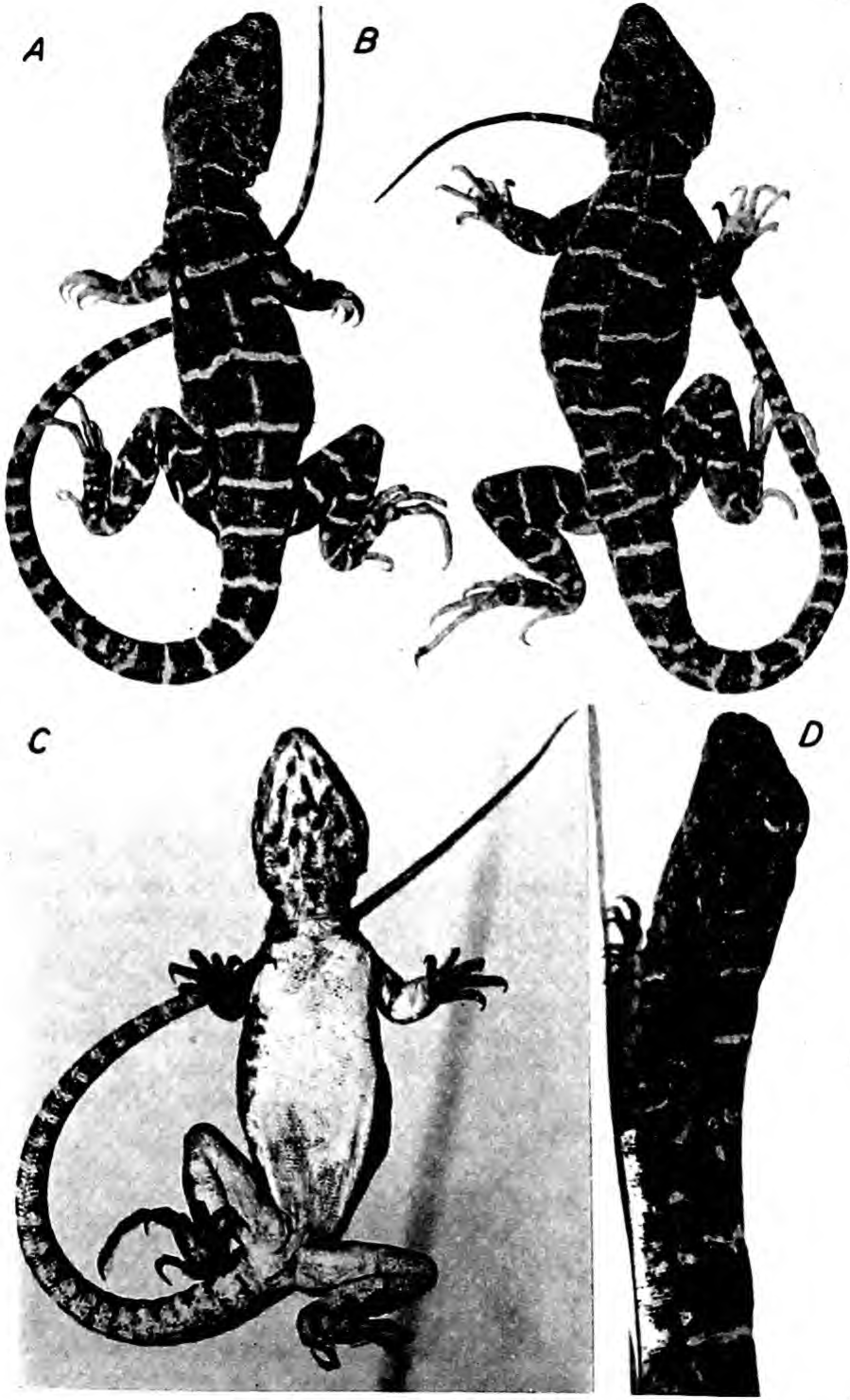
Color. Much like that of young *w. wislizenii*. Seven to 10 distinct, white or cream, transverse bands extending far onto the sides on the body; the bands of the two sides may meet medially, or if not they terminate on the middorsal line. The spaces between the crosslines may be light gray-brown or darker brown, and small, light brown, dark-edged spots are scattered about in them; these spots may be completely absent, or fairly well defined; in young specimens there tends to be but one spot on each side between each pair of lines, and each spot is rather large; in older specimens the spots become smaller and more numerous. The base of the tail is similarly marked, and distally on the tail are rows of spots that produce a more or less cross-banded effect. The limbs have light crossbands, becoming less evident in old specimens.

On the ventral surface of the head are a number of dark spots and lines, seldom fused in such a way as to produce distinct longitudinal dark lines. Belly lemon yellow in life in adults, whitish in young and in preservatives.

Scalation. As in *w. wislizenii* (Fig. 68) except that the femoral pores vary from 15 to 20, and the head is shorter and broader. The most important feature of the head proportions is that the greatest width of the head is about equal to the distance from the nostril to the anterior border of the ear.

Recognition Characters. The distinguishing characters of this race and the common leopard lizard are listed in the discussion of the latter species. The only differences between the two are (1) the shorter head of the present species and (2) the retention in adult *w. silus* specimens of the light crossbands characteristic of the young of both *w. silus* and *w. wislizenii*.

Habits and Habitat. Presumably as in the "common" race. Heller (in Van Denburgh) has recorded the only notes on this race, stating that it "is very wary, which is doubtless due to the open and exposed nature of their habitat. They are found in abandoned burrows of the Kangaroo-rat, *Perodipus*. All stomachs examined contained grasshoppers."



Pl. 31. *Gambelia wislizenii silus*. Coalinga, California. A, C, D, females; B, male.

Problems. The relationships of this form are not well worked out, and its life history is practically unknown. Because of the slight differences of *w. silus* from *w. wislizenii,* its geographically adjacent range, and the probability of coincidence of ranges and of intergradation at that point, it is assumed here that *silus* is a subspecies of *wislizenii,* although other authors have treated the two forms as full species. The question was discussed by Stejneger in 1893 but has received no published comment since that time. Having two specimens from two localities on the west slopes of the Sierra, practically in the San Joaquin Valley, typical of *wislizenii,* Stejneger concluded that intergradation is unlikely: "If we were ever to find intermediate forms between the two species, specimens from these localities would be expected to furnish them, but it is a significant fact that they are as typical as any of the specimens collected outside of the great interior valley of California." This matter is one concerning which an insufficient amount of data is available at present to warrant sustained argument. If regarded as specifically distinct from *wislizenii,* the form should be known as *Gambelia silus* (Stejneger).

References. Stejneger, 1893, p. 170 (*Calif.*); Van Denburgh, 1922, pp. 128–131, pl. 9, description, habits (*gen. lit.*).

The Collared Lizards

Genus *CROTAPHYTUS* Holbrook

These large, gangling, conspicuous, wary, and pugnacious lizards are so very different from the leopard lizards in habits and body form that they are here separated into distinct genera. Although the two groups are without doubt closely related, they are more strikingly different from each other in form than the members of any single genus of the country. Some details of the scutellation of a typical form of *Crotaphytus* are shown in Fig. 69.

Both species of *Crotaphytus* are terrestrial, although one inhabits bouldered areas, the other flat plains where it seeks protection in rodent burrows. Both are insectivorous and egg-laying. A feeble throat fan occurs in males and is presumably used in intimidation of competitors.

KEY TO SPECIES OF *CROTAPHYTUS*

1. A pair of black rings about neck, generally incomplete ventrally and sometimes middorsally also; dorsal pattern not boldly reticulated; scales between subocular and labials reduced to 2 rows at some points (Fig. 69C) 2

   No black rings about neck although sometimes evident on shoulders;

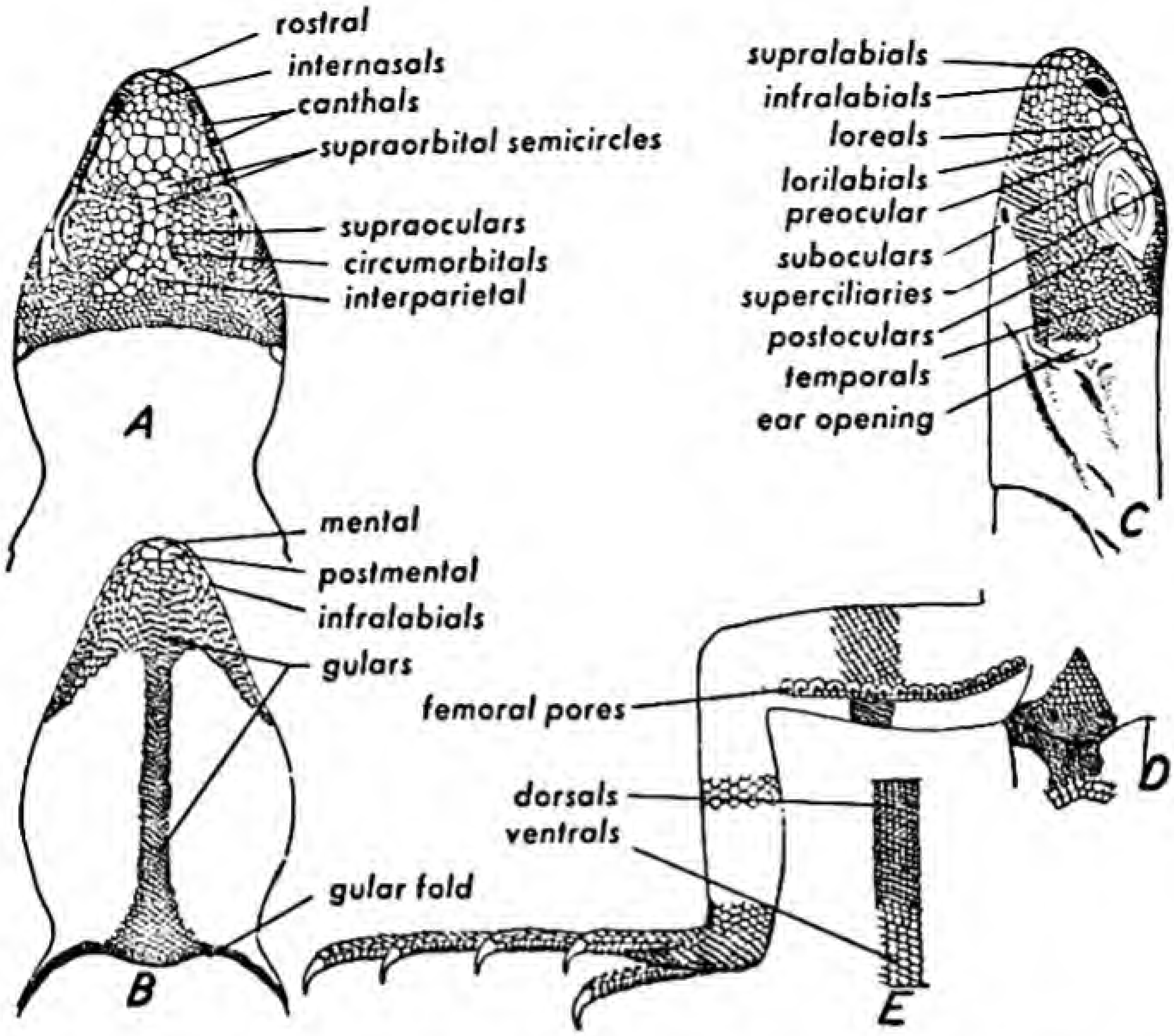


FIG. 69. Typical scutellation in *Crotaphytus*, from *C. collaris baileyi*, Lake Valley, New Mexico. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

dorsal pattern boldly reticulated; scales between subocular and labials not reduced to less than 3 or 4 rows at any point (Fig. 70) . . . . *reticulatus* (p. 173)

2\. Large scales between orbits in 2 complete series, without a fusion of scales of the two series (Fig. 69A); gular region of males boldly reticulated . . . . *collaris baileyi* (p. 170)

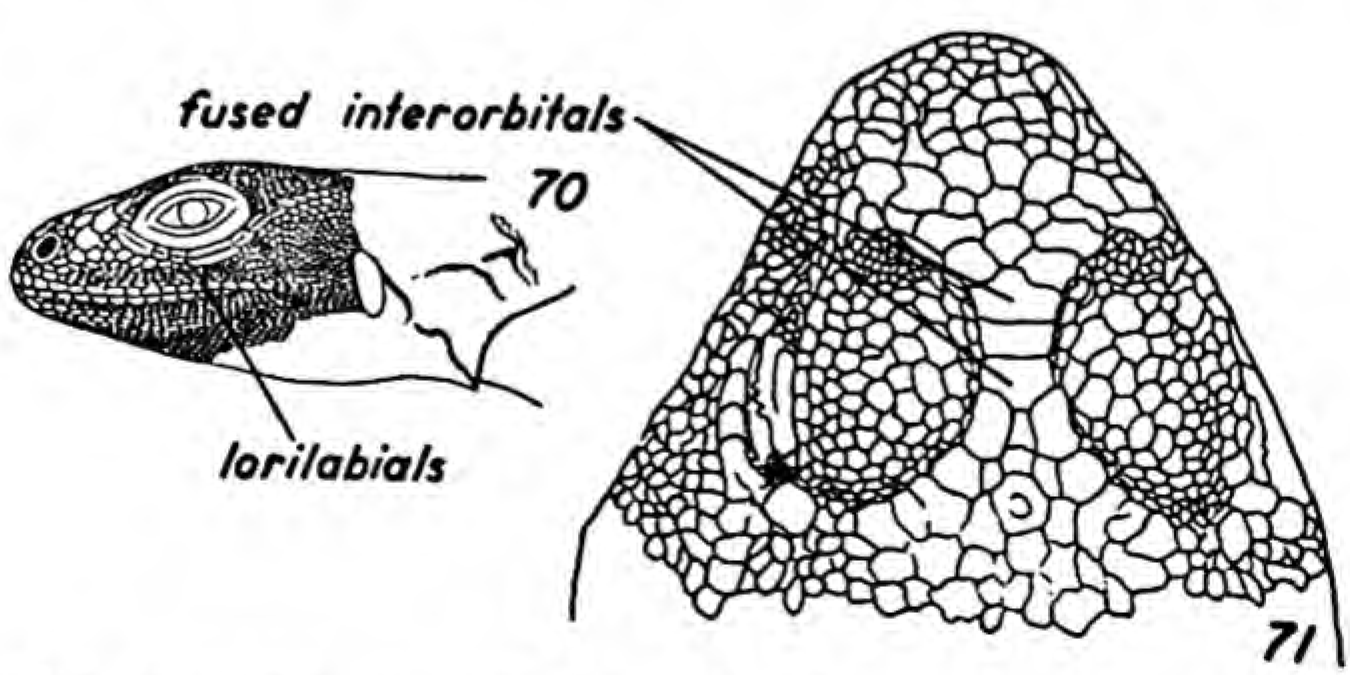


FIG. 70. *Crotaphytus reticulatus*, side view of head. From Cope.
FIG. 71. *Crotaphytus c. collaris*, top of head. From Burt.

One to 4 pairs of scales in the two interorbital series of scales fused (Fig. 71; gular region of males not reticulated . . . *collaris collaris* (p. 168)

Eastern Collared Lizard *Crotaphytus collaris collaris* Say

(Fig. 71, p. 167; Pl. 32)

Range. The central plains region in hilly or canyon areas from northern Kansas (probably southern Nebraska) southward to extreme northeastern Mexico, east to southeastern Oklahoma, and through the Ozark Proplateau in the southern half of Missouri and the northern half of Arkansas; west through southeastern Colorado, eastern New Mexico, and about the Pecos River. Type locality—Verdigris River near its union with the Arkansas River, Oklahoma. (Map 8, p. 490.)

Pl. 32. *Crotaphytus collaris collaris.* Manhattan, Kansas. Gloyd photograph.

Size. These are big-headed, narrow-necked, gangling lizards with a long round tail. They reach a maximum snout-vent length of about 115 mm.; the tail is usually about twice as long as the body. Males have a notably broader, more muscular head than females. The hind legs are larger than the forelegs, about as long as the head and body.

Color. Males of this species are very brightly colored. The ground color is straw yellow, sometimes tinged with orange. The head is uniform, without dark markings, except sometimes for dark labial bars or a suffusion of black on chin and throat. A black collar, broken in the middle, extends from the insertion of the arms, or just above them, dorsally around the neck. A short distance anterior to this collar is another narrower one very broadly broken medially; it terminates in the sides of the neck in front of the arm insertions. Crossing the back are usually about 6 narrow dark slate-gray crossbands;

these are very variable in distinctness, in some cases very prominent and in others scarcely visible. Blue spots are scattered near the edges of the dark bands. The hind legs have broad dark brown or gray bands; the tail has somewhat narrower, irregular, usually indistinct, dark bands. The ground color is more brilliant aand suffused with orange more strongly toward the posterior part of the body and on the hind limbs and the tail.

The females are colored and marked like the males except in less brilliant tones; the orange suffusion seldom occurs in them.

Young specimens also usually lack the brilliant colors, and the markings are a little different. The neck collars are very broad and may have a coarse reticulation of light marks on a dark background; the dark crossbands on the body tend to be more distinct and black instead of brown or gray; the crossbands on the body also may enclose large, more or less circular, light marks. The breaking up of these circular marks results in the blue spots near the edges of the crossbands in adults. In very old specimens the crossbands disappear completely and the only distinct markings remaining may be these light flecks.

Below the color is white or cream, with no dark markings save a coarse reticulation toward the sides of the lower jaw. This reticulation is very prominent in small specimens and becomes dim in larger ones. Adult males may have the throat orange or yellow.

Scalation. Similar in most respects to that shown in Fig. 69 (p. 167). The scales on the back are very small and smooth; on the belly they are a little larger. The tail scales are about halfway between the dorsal and ventral body scales in size, and are not pointed. There is an irregular group of supraoculars, and bordering each group medially is a series of larger scales that usually combines with the opposite series in the middle between the orbits (Fig. 71). The tail, when broken, cannot be regenerated as it can in most lizards; if regeneration occurs it is very slow. Ear large, oval, without protection. The femoral pores vary from 14 to 27, and average 18, on each side. The males lack enlarged postanal scales.

Recognition Characters. No other lizard species in the United States has a long tail, fat body, slim neck, big head, and a double black collar, except the western collared lizard, the western subspecies. The differences between these two subspecies lie partly in the nature of the row or rows of scales between the orbits. In the western race there are 2 complete rows between the orbits; in the eastern subspecies 1 to 4 broad scales interrupt the double series. About 80 per cent of eastern specimens have the scales thus arranged, and about 80 per cent of the western specimens have them arranged in the opposite manner. In the area between, in central New Mexico and Colorado, the proportions may be intermediate. It is to be emphasized that, without reference to locality, single specimens or even series of several specimens may not be definitely identifiable by use of this character; the races are defined by averages based on large

series. There is a well-defined difference in the throat markings of adult males, the western race having a bold reticulation, the eastern race having labial bars, no markings at all, or a general dark suffusion.

Habitat. These lizards are very common on the limestone-capped hills of central Kansas, where they reach perhaps their maximum abundance. They are restricted to rocky areas or canyons in the prairies, and thus do not occur in the vast expanse of flat prairie in western Kansas, Oklahoma, eastern Colorado, and northeastern New Mexico. Open hillsides where shade is scanty are preferred; heavily shaded hills are seldom inhabited, and perhaps for this reason the species becomes rarer in the heavily wooded Ozark Mountains.

Habits. The pugnacious habits of these lizards are well known. Their discrimination must be poor, for they will act threateningly at almost any movement, when startled, whether the moving object be a dog, human, or train. They are not usually thus taken by surprise, however, but sight intruders from considerable distances and take refuge under stones or in cracks before the wanderer arrives on the scene.

The eggs vary from 4 to 24, according to published accounts, and may be deposited in loose sand to a depth of 4 or 5 inches, or in tunnels underneath rocks.

The food consists largely of grasshoppers, in central Kansas, but includes other large Arthropods, such as spiders, beetles, moths, etc. Small vertebrates, including other lizards, are occasionally eaten.

For further comments see the discussion of the western collared lizard.

Problems. Aside from the life history problems the most interesting investigation needed for an understanding of the collared lizard is a study of the southern and southwestern limits of distribution of the eastern race, and the exact area of intergradation with the western race. Large series from numerous localities will be necessary for such a study.

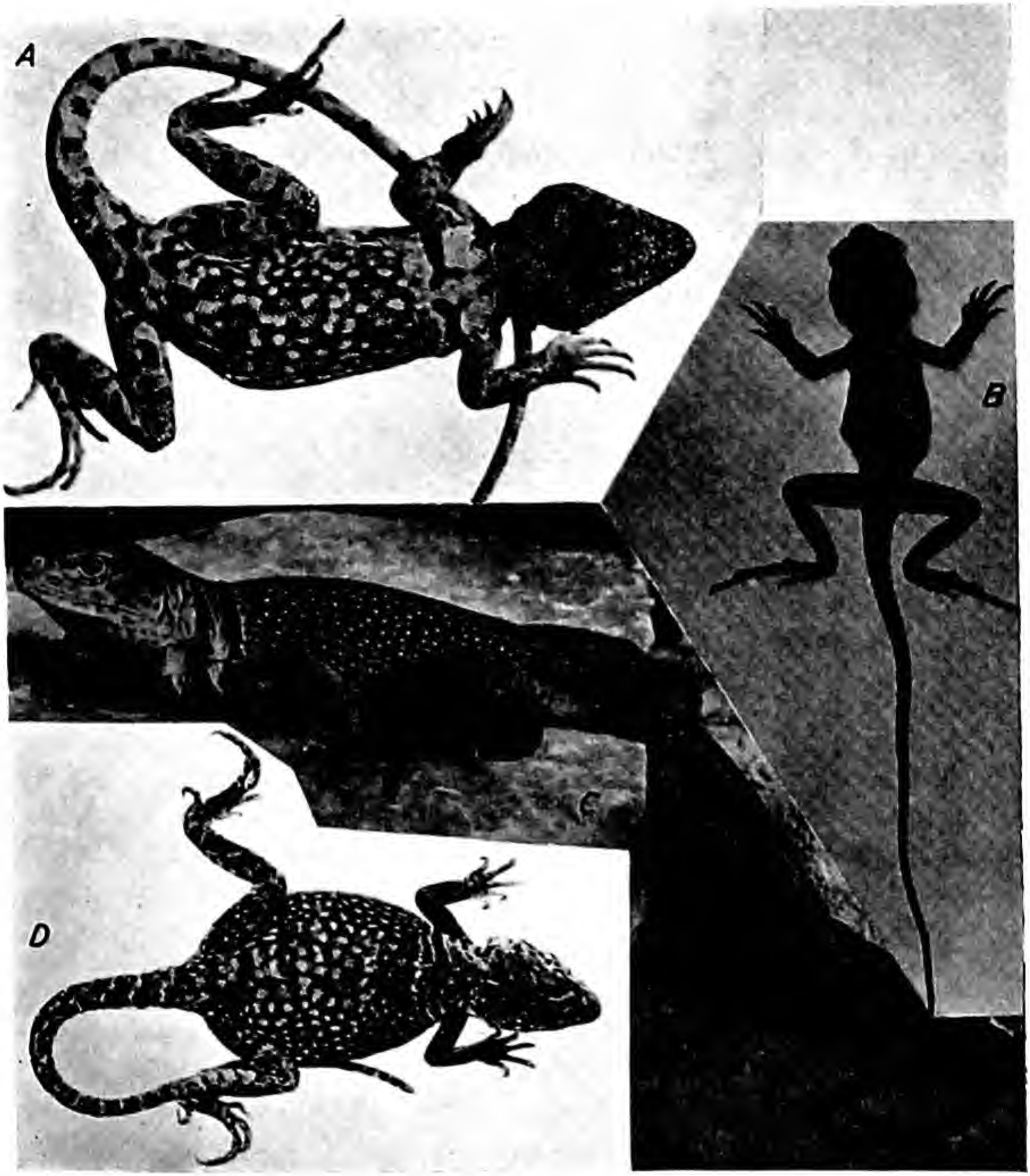
References. Burt, 1928, pp. 51–53, food (*Kans.*); *idem,* 1928, pp. 5–11, description, Kansas specimens (*Kans.*); *idem,* 1928, pp. 1–19, pls. 1–7, variation and distribution (*gen. lit.*).

Western Collared Lizard *Crotaphytus collaris baileyi* Stejneger

(Figs. 49, 50, p. 90; Fig. 56, p. 91; Fig. 69; Pl. 33)

Range. Mountainous and canyon areas west from central New Mexico and western Colorado to eastern central Oregon and central California; south through northern Mexico. Type locality—Painted Desert, Arizona. (Map 8, p. 490.)

Size. About the same size as the eastern race, with a maximum length, snout to vent, of about 112 mm. (4⅜ in.). The tail is about twice as long as the body.



Pl. 33. *Crotaphytus collaris baileyi.* A, Devil's River, Texas; adult. B, same locality; young. C, Glenwood, New Mexico; adult. Gloyd photograph. D, New Braunfels, Texas; female.

Color. Much the same as the eastern collared lizard. The black neck collar may extend ventrally around the neck, in males, fusing with a black color that covers the entire throat and chin; all except the central posterior part of this area is reticulated with light lines, producing a very striking pattern.

Scalation. See Fig. 69. As in the eastern collared lizard except that usually (about 80 per cent of specimens) there are 2 complete, uninterrupted rows of scales between the orbits.

Recognition Characters. The peculiar body form, double black neck collar, and complete double row of scales between orbits will identify this race of lizards. For a comparison with its nearest relative, the eastern collared lizard, see the discussion of the latter.

Habitat. Rocky places are preferred. Large boulders are not frequented since these lizards, not adept climbers, find the nearly vertical slopes of large boulders difficult to manage. Cliffs, for the same reason, are not usually inhabited. They have been recorded from bushy flats, where they seek refuge in small mammal holes, but this is not typical. In many places they may forage for food on the ground, but usually they are near rock piles where they can hide when disturbed.

Habits. If startled on flat ground where they can reach high speed in movement, they use only the hind legs, lifting the whole fore part of the body and the forelegs completely off the ground. Running in such a curious pose, they look like diminutive racing dinosaurs, waddling slightly as they rush along.

The ferocity of these lizards has been commented upon by many writers. When first captured they bite very readily, and for a short time after, the males, whenever startled, may open the mouth in readiness to bite. The cavernous mouth is lined with black skin on the interior. However, after very little handling the lizards seldom bite and can be held with impunity. This may be due to the usual lack of sunshine in the cages where they are kept, for several observers have reported that they regain their old ferocity to a certain degree after being exposed to the sun's rays a short time. The bite, while vicious, may be so large as not to be painful; the largest specimens cannot cause pain when biting the fleshy part of the hand. If a small piece of skin is grabbed, the small teeth may well pierce the skin. Fortunately, when they have secured a hold on some part of the hand and are released to dangle freely, they usually are willing to drop without struggling after a few seconds. An attempt to shake them off usually causes the lizard to tighten its grip.

The food consists of almost any type of insect and small lizards. Adults in captivity eat small ones in the absence of other food and cannot be trusted in the same cage with any other kind of small lizards, even horned lizards. Some observers report that flowers and tender leaves may be eaten.

One female has been observed to lay 21 eggs early in August (in captivity). The eggs measure 16 x 11 mm.

Problems. As noted before, one of the most interesting problems concerning the collared lizards is the exact location of the area of intergradation between the two races. Large series from numerous localities from New Mexico, Colorado, and Texas will be necessary.

References. Burt, 1928, pp. 1–19, pls. 1–7 (part) (*gen. lit.*); Van Denburgh, 1922, pp. 104–114, pl. 7 (*gen. lit.*).

Reticulate Collared Lizard *Crotaphytus reticulatus* Baird

(Fig. 39, p. 88; Fig. 70; Pl. 34)

Range. Extreme southern Texas and adjacent Mexico, from near Mission to Eagle Pass.[4] Type locality—Laredo and Ringgold Barracks, Texas. (Map 9, p. 491.)

Size. Large adults measure about 115 mm. ($4\frac{9}{10}$ in.) from snout to vent; the tail measures a little more than twice the head-body length. The head is broad, the neck relatively slender, the body fat, the limbs strong; the hind legs are about twice as long as the forelegs.

Color. The general dorsal color is a gray-brown to reddish brown. Narrow light lines form a rather regular, open network on the back, outlining more or less rounded areas having an average diameter of about 9 scale lengths. These rounded spots may have slightly darker edges and frequently have a light central spot. Certain of the dark areas are black instead of the usual color; these black spots are arranged more or less in linear series, 1 on either side of the middorsal line, and 2 or 3 others on the sides; the spots are arranged opposite each other, in transverse series, and sometimes adjacent spots are fused across the back. The light borders of the black spots are more conspicuous than the others. The tail and limbs have a reticulated pattern like the back, but none of the cells are black.

Males are marked like females, except for having 2 vertical black bars on the shoulders, separated from each other by a narrower light line, and not reaching to the median dorsal line. Adult males also have the gular region and the femoral pores black. In both sexes there is a dim mottling or reticulation on the chin and sides of the lower jaw, as well as on the sides of the abdomen. Otherwise the ventral surfaces are cream, unmarked.

Scalation. Dorsal scales all very small, smooth, convex; a row of supraorbital semicircles on each side not fused where they meet medially; subocular broken into several scales, separated from labials by 3 or 4 rows of small scales (Fig. 70); several strongly keeled postoculars; a pair of enlarged scales bordering mental posteriorly, in contact with each other medially and with the first labial laterally. Postanals not enlarged in males. Femoral pores 16 to 19 in four specimens. Tail scales all prominently keeled except those near base.

Recognition Characters. The large head and slender neck will identify members of this genus at a glance. Only the forms of *collaris* can be confused easily with the reticulate collared lizard. These are very different in pattern, however, one having a double collar about the neck, the other lacking it or having only small evidence of it on the sides of the neck. *C. collaris*, moreover,

[4] Stejneger and Barbour (1943, p. 68, *gen. lit.*) say this species occurs in "extreme southwestern Texas, and adjacent Louisiana." It would be very surprising to find it a normal inhabitant of the latter state. I have not been able to find a record of it.

Pl. 34. *Crotaphytus reticulatus.* A, B, Roma, Texas; male. C, Edinburg, Texas; female.

does not have the peculiar reticulated pattern on the back that characterizes this species. Differences in scalation between the two are few, but among them can be cited (1) the distinctly keeled dorsal and lateral tail scales in *reticulatus* (smooth or obtusely keeled in *collaris*), and (2) the reduction in *collaris* to 2

rows of the scales at some point between the subocular and labials (in *reticulatus*, 3 or 4 rows are complete in this area).

Habits and Habitat. In southern Texas I have seen these lizards near the banks of arroyos, dashing from one burrow to another as rising floodwaters forced them to quit their normal refuges. Brown says:

> During cold weather the lizards were found coiled in burrows slightly larger than their bodies. A passageway, leading from the burrow to the outside of the rock covering the burrow, was always found closed with dirt. No specimens of the lizard were taken in burrows during warm weather but rather from temporary hiding places such as trash piles, brush piles, or pack-rat nests. It was noted that the reticulated pattern of those taken during cold weather was almost indistinguishable, although the pattern of specimens taken during warm weather was well defined and quite bright. When handled, *Crotaphytus reticulatus* would bite fiercely at anything within reach. Even when sluggish with cold, the lizards would open their mouths in a defensive attitude when disturbed. In the field they were very shy and difficult to approach. In captivity they could not be made to eat or drink.

Problems. This is one of the least known lizards of the country. In addition to its life history, which is practically unknown, its relationship to *collaris* needs investigation. The restriction of the species to the lower Rio Grande Valley is extraordinary.

References. Brown, 1942, p. 176, records, habits (*Tex.*); Cope, 1900, pp. 254–255, fig. 20, description (*gen. lit.*); Smith, 1938, p. 149, records (*Tex.*).

The Collared Utas

Genus *STREPTOSAURUS* Mittleman

Only two species, *mearnsi* and *repens*, belong to this genus. They are bizarre-looking lizards, greatly flattened and of moderate size. The genus is restricted to extreme southern California and Baja California. Some details of the scutellation of a typical species are shown in Fig. 72.

Californian Collared Uta *Streptosaurus mearnsi* (Stejneger)

(Fig. 51, p. 90; Fig. 72; Pl. 35)

Range. Southern California and the northern half of Baja California, southward on the Pacific slopes of the coastal mountain range from San Gorgonio Pass through Riverside, San Diego, and Imperial counties. Type locality—summit of the Coast Range, Mexican boundary of California (probably near Jacumba). (Map 9, p. 491.)

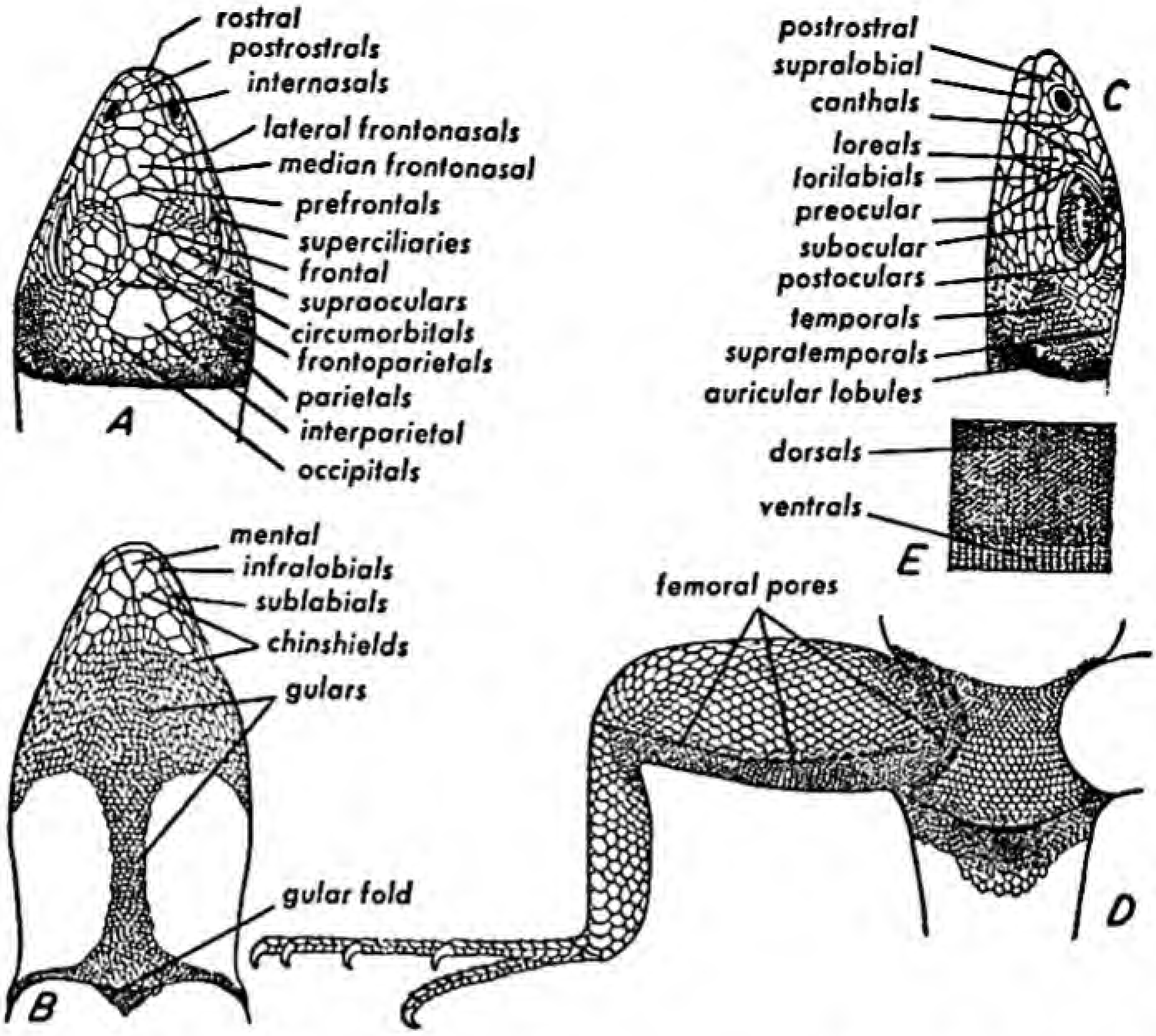


FIG. 72. Typical scutellation in *Streptosaurus*, from *S. mearnsi*, southern California. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of side of body. From Cope.

Size. A rather large species, reaching a snout-vent measurement of 90 mm. ($3\frac{9}{16}$ in.). The tail is about twice as long as the head and body. The body and head are flattened to a considerable degree.

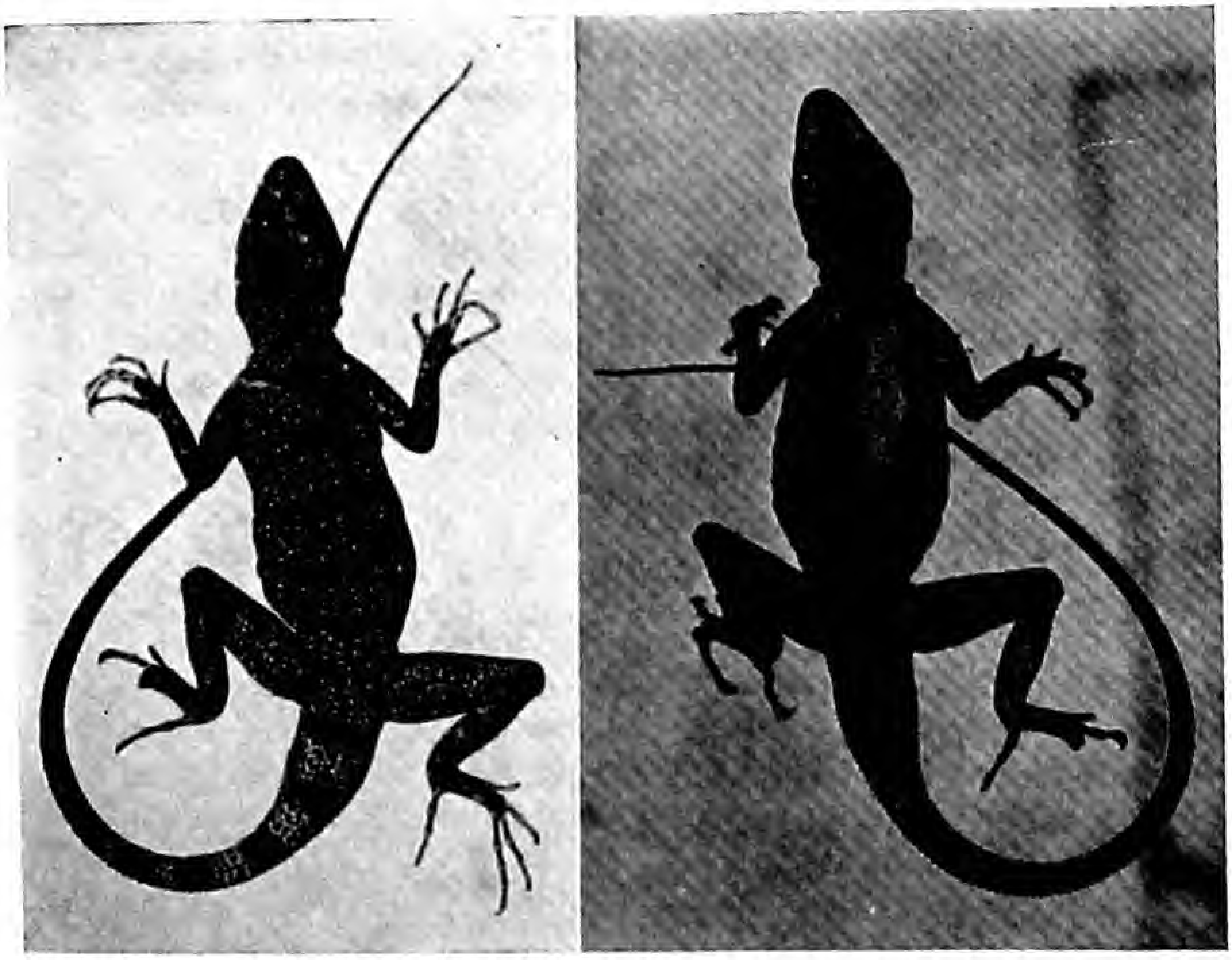
Color. Dorsal ground color olive gray, becoming brownish on the head. About 7 slightly darker, rather narrow, undulating crossbands extending across the back. The band across the shoulders is darker than the others and is black in front of the arm insertion. There are a number of tail bands, distinct on all except the distal portion of the tail; these bands are usually a little longer than the spaces between and, unless the whole subcaudal surface is dark, can be seen on the ventral surface. The body, between the dark bands, is dotted with numerous small, white or bluish spots. The limbs are dimly banded.

In both sexes the throat is coarsely reticulated with bluish gray, more prominently in males. In the latter the remainder of the ventral surfaces, including the limbs and tail, are dark (indigo in life), except for irregular white or cream areas on the preanal and chest regions.

Scalation. See Fig. 72. The scales around the body are of very nearly equal size, the dorsals intermediate between the slightly smaller laterals and slightly

larger ventrals; the latter are overlapping, the others granular, juxtaposed; the caudal scales are large, pointed, and, except on the ventral surface, heavily keeled. The granular gular fold is present. The ear is bordered anteriorly by 5 or 6 elongate lobules (scales).

The head scales are enlarged, flat; the frontal is divided; there are 3 or 4 enlarged supraoculars. Femoral pores 19 to 25. Males with enlarged postanals. A small postfemoral dermal pocket.



Pl. 35. *Streptosaurus mearnsi.* Andreas Canyon, California; female

Recognition Characters. The large size, flat body, and peculiar pattern distinguish this lizard from all others. From the other species with similar body form it may be distinguished by the divided frontal, the presence of the ear opening, normal (not diagonal) labials, nearly equal body scales, the granular dorsals, and numerous femoral pores.

Habitat. This is one of the most completely saxicolous (rock-dwelling) lizards of the country. They are restricted to barren, rocky canyons, where they live among large boulders.

Habits. Practically nothing has been recorded. Near Jacumba Klauber says they are exceedingly common, and in late May appeared

most plentiful between 7 and 8, about 100 being seen within the hour. A secondary period of activity was noted between 4:30 and 5:30 p.m., but there were fewer than in the morning.

Uta mearnsi is quite inquisitive and consequently can be easily stalked. However, it must be hard hit, for it will usually escape unless some of the fine shot take effect in the head. The ones that are so hit usually stick to the rock to which they were clinging. *Mearnsi* never seems to seek refuge in ground holes; always when pursued it jumps from rock to rock until a suitable crevice is found. In so doing it runs equally well on the tops or on the vertical sides of the boulders; and I have even seen one running on the underside of a boulder with the slope not more than 10° from horizontal. When not frightened it has a peculiar waddling gait.

Color change in this species, which involves simply a darkening or lightening of the pattern (particularly the light areas), is correlated directly with temperature change and is not influenced by some factors which cause change in other species of lizards. At a temperature above about 105° F. it assumes its light phase; below that temperature it is in its dark phase.

Problems. The life history of this interesting species is practically unknown. A careful study of its relationship to other genera is much to be desired; this should include an osteological study.

References. Atsatt, 1939, pp. 254–255, pl. 11, fig. 7, color change (*lit. cit.*); Klauber, 1939, pp. 32, 65, 69, 88, table 15, habits (*Ariz.*); Mittleman, 1942, pp. 111–113, relationship (*gen. lit.*); Van Denburgh, 1922, pp. 191–194, pl. 15, description, range (*gen. lit.*).

The Pored Utiform Section

Three genera of this section occur in the United States: *Sceloporus, Urosaurus,* and *Uta.* The last two seem to be derivatives of *Sceloporus,* which is an old and prolific genus. They definitely do not appear to be of common ancestry within *Sceloporus;* one, *Uta,* has pretty surely been derived from the *variabilis* group of *Sceloporus* (near *couchii*), and the other may well have been derived from the *merriami* or the *maculosus* groups or their common ancestors. It is only by virtue of the development of a character unique among *Sceloporus* derivatives that *Uta* and *Urosaurus* can be distinguished generically from the other derivatives (in reference to any of the many groups still incorporated in the genus *Sceloporus*), and it is only because both independent derivatives now known as *Uta* and *Urosaurus* happen to have developed the same character, the gular fold, serving to distinguish them from *Sceloporus,* that authors in the past considered the two stocks congeneric. I agree with Mittleman that they clearly are not. It is a curious fact that all genera that have sprung from *Sceloporus* have developed a gular fold—including *Sator,* a Baja California genus. The tendency to develop this fold appears to be restricted to the primitive groups of *Sceloporus,* such as *variabilis,*

merriami, maculosus, and *pyrrhocephalus;* and these are the groups from which *Uta, Urosaurus,* and *Sator* independently appear to have been derived. That the degree of difference between the several species contained in each of these four genera is not the same for all is to be expected since some, obviously, are much older than others.

All species of this section lay eggs, except for a few species of *Sceloporus.*

The Rough-scaled Lizards

Genus *SCELOPORUS* Wiegmann

This genus has more representatives within the boundaries of the United States than any other, 27 now being recognized. One other (*couchii*) has been recorded, but probably in error, since the species is a mountain lizard and the Texas locality at which it is supposed to have been found is a nearly flat plain. The genus is distributed from British Columbia and southern New York southward to Panama, and is represented by 102 recognized forms. Although a large genus, it is greatly exceeded in number of forms by *Anolis,* which contains three times as many as *Sceloporus. Anolis* is a more tropical genus, however, with only two species occurring in the United States.

In a large genus such as this considerable variation in habits may be expected, and does exist. There is also much variation in external morphology, mostly in scalation, but there is extraordinarily little divergence of form. Head, body, and limbs are of the same form throughout the entire genus; in tail form there is some variation, a few species having extremely elongate tails and a few others having compressed tails. For the most part, however, once a person is familiar with one or two species of the genus, he has no trouble recognizing other forms as belonging to that genus. The chief difficulties will be putting too many forms in that genus; that is, failure to distinguish particularly *Uta, Urosaurus,* and *Streptosaurus.* So, in addition to recognizing the distinctive body form, one should also look on the ventral surface of the throat for a granular fold; if there is one, the lizard is not a *Sceloporus.* This fold is possessed by all three of the other genera mentioned above, as well as by several that have no special resemblance to *Sceloporus.*

The variation in scalation is great interspecifically, and not inconsiderable intraspecifically. J. Paul Jones, a student of this genus, once observed that if a single character is selected to identify each species of the genus, one could find each one duplicated in various specimens of one single common species of central and eastern United States (*S. undulatus* and its subspecies). This is not strictly true, but it emphasizes the fact that rare specimens show variations

not at all of the commonly expected type, and that, therefore, we must consider a species or race to be identified by all its characters combined, not by a single one, and by the general status of the whole population of that race in regard to those characters, rather than by the status of a single specimen. Given such terms it is not surprising that keys will not always prove satisfactory as the means of properly identifying single specimens. Some details of the scutellation of a typical form are shown in Fig. 73.

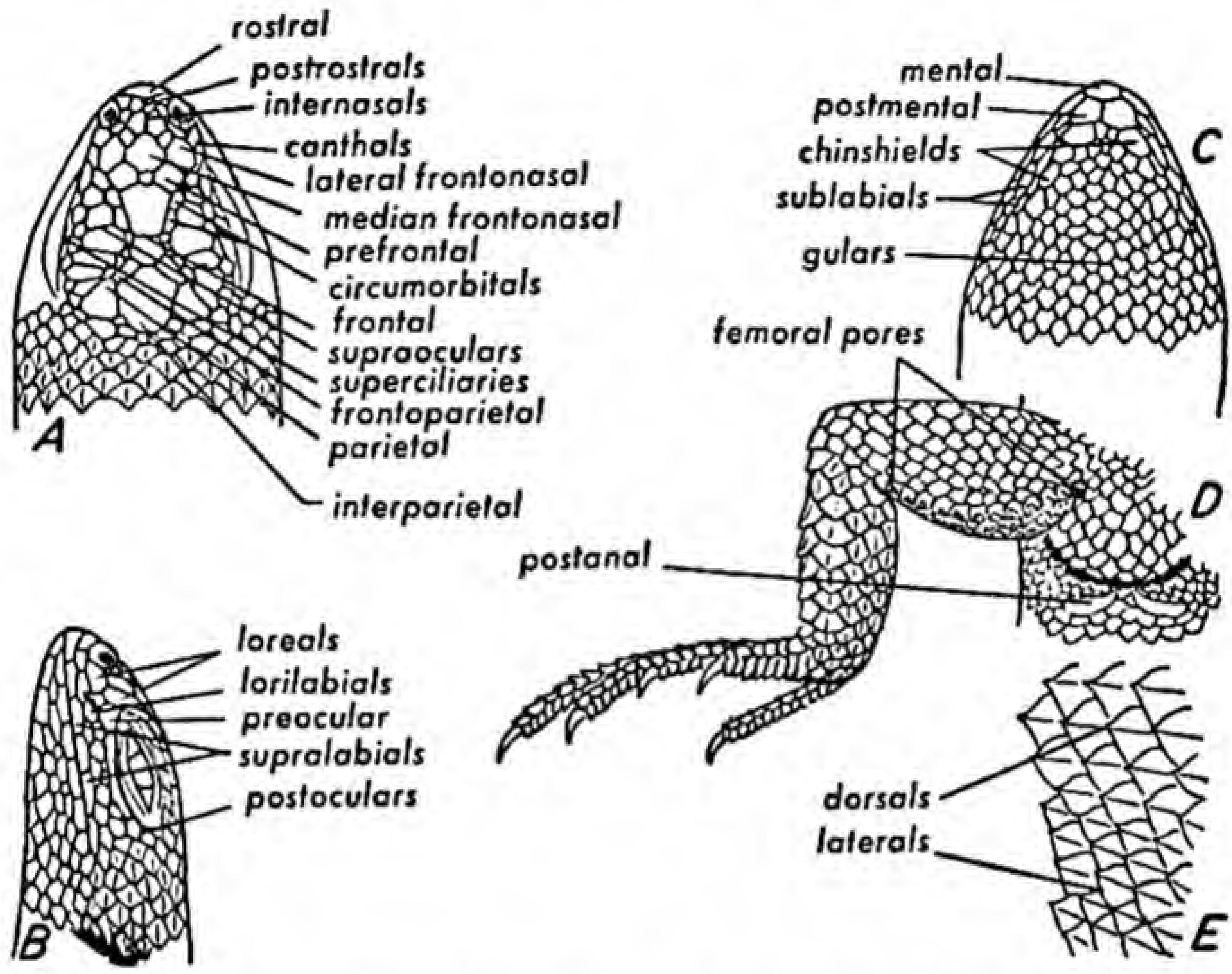


FIG. 73. Typical scutellation in *Sceloporus*, from *S. u. undulatus*, Alabama. A, top of head; B, side of head; C, underside of head; D, ventral view of right hind leg and anal region; E, section of side of body. From Cope.

The variation in habits is perhaps most surprising of all. The chief characteristic of the lizards is their active ubiquity. They inhabit almost every sort of terrain, except the highest peaks and aquatic or subaquatic environments, above the surface of the ground. They have never degenerated to the habit of underground life. They are strictly diurnal; if any are seen active at night, it is because of some unusual condition. Some are inveterate climbers, others seldom leave the ground; some give birth to young, others lay eggs. This latter variation—both ovoviviparous and oviparous forms in one genus—is known also in the skinks, *Eumeces*, and the horned toads, *Phrynosoma*.

While variation such as that summarized above is sometimes disheartening, it makes possible a clearer segregation of the many species into groups of related forms than might otherwise be possible. In the whole genus fifteen groups have been defined, and eight of these are represented in the United States. Our species are segregated into their respective groups in the following

treatment in order to facilitate identification and discussion and to show relationship where possible.

KEY TO SPECIES OF *SCELOPORUS*

1. A postfemoral pocket present (Fig. 74); dorsal scales from occiput to base of tail, 58 to 69; males with pink belly patches . . . . *variabilis marmoratus* (p. 186)
   No postfemoral pocket; dorsal scales less numerous or not; males not with pink belly patches 2

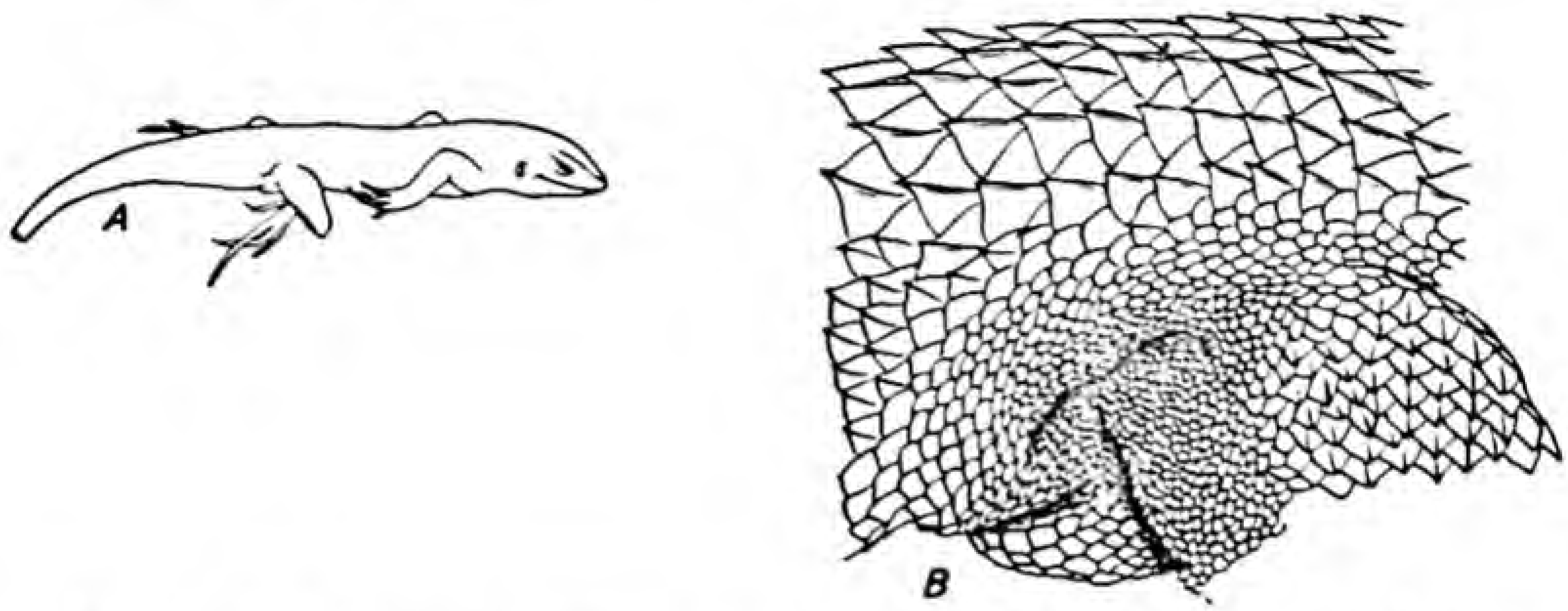


FIG. 74. *Sceloporus variabilis marmoratus.* A, side view; the stippled area indicates the portion of the body enlarged in B. B, side of anal region, showing postfemoral pocket. From Smith.

2. Lateral scales very small, granular, not overlapping; dorsal scales, 47 to 70; a rudimentary, granular, gular fold on each side in front of shoulder; femoral pores, 19 to 30, the two series in contact medially or separated by not over 5 scales 3
   Lateral scales larger, not granular, overlapping; dorsal scales variable; no rudimentary gular fold; femoral pores similar or not . . . 4
3. Anterior section of frontal usually divided; frontoparietals usually divided; first infralabial and first postmental usually in contact throughout their length; head scales rugose; subcaudal surface distinctly banded; gular bars extensive, confluent medially . . . . *merriami annulatus* (p. 190)
   Anterior section of frontal usually entire; frontoparietals seldom divided; first infralabial partially separated from first postmental; head scales smooth; subcaudal surface nearly or quite immaculate, not barred; gular bars short, usually separate medially . . . . *merriami merriami* (p. 188)
4. Lateral scales in longitudinal series parallel to the body axis; 2 postrostrals; femoral pores 12 to 18 on each side, the two series in contact medially or separated by no more than 2 scales . . . *scalaris slevini* (p. 191)
   Lateral scales in oblique series ascending posteriorly; usually 4, sometimes 3, 5, or 6 postrostrals; femoral pores variable . . . 5

5. Supraoculars very large, in a single row, usually 5 in number, and the last one or two *not* separated from the median head scales by a row of small scales as are the other supraoculars (Fig. 75) 6
   Supraoculars smaller, in a single or double row, variable in number, but all separated from median head scales by a complete row or two of small scales (Fig. 73) 8

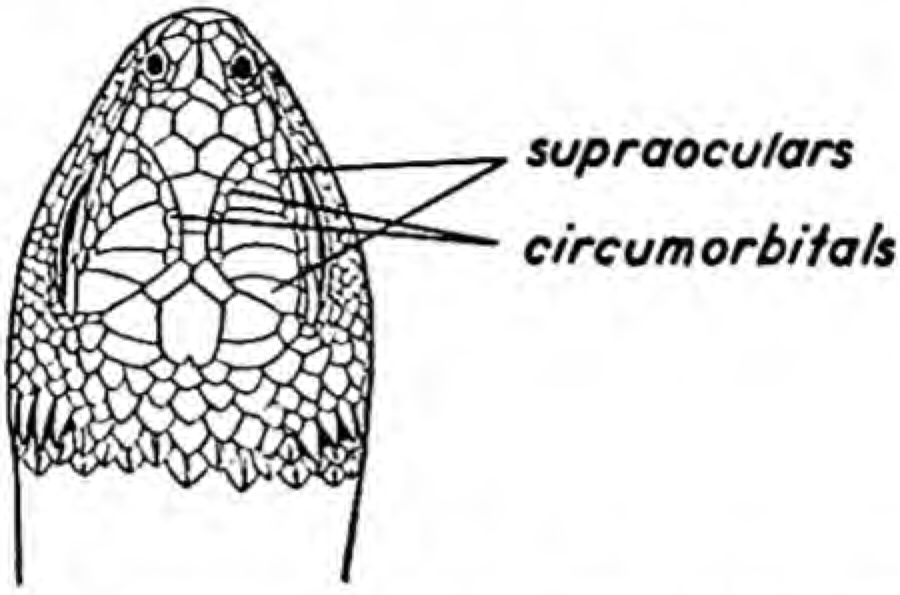


FIG. 75. *Sceloporus orcutti,* top of head. From Cope.

6. Auricular scales elongate (Fig. 75), about 5 in number, the upper not largest; *and* first infralabial at least partially in contact with first postmental; black shoulder patch indistinct; dorsal scales with a deep notch on either side of median spine; entire ventral surface dark blue and each dorsal scale with 1 or more light streaks on a dark background in adult males .... *orcutti* (p. 208)
   If auricular scales as described, then first infralabial completely separated from first postmental; or if infralabials and postmentals as described, then auricular lobules 3, the upper largest and rounded; black shoulder patch distinct in adults; dorsal scales not deeply notched; pattern of adult males not as described 7
7. Auricular lobules generally 3, upper largest and rounded; forelegs distinctly crossbarred; first infralabial at least partially in contact with first postmental; 1 parietal on each side; first canthal seldom directly in contact with lorilabials; nuchal collar indistinct dorsally .... *clarkii clarkii* (p. 206)
   Auricular lobules generally 5 to 7, all elongate and pointed, median ones largest; forelegs not crossbarred; first infralabial generally separated from first postmental; 2 parietals on each side; first canthal generally in direct contact with lorilabials; nuchal collar quite distinct dorsally although generally broken in middle .... *magister magister* (p. 211)
8. A broad, black collar across back of neck, bordered anteriorly and posteriorly by a light line 9
   No distinct, light-bordered, black, nuchal collar 11
9. Dorsal scales 40 or more (40 to 46); supraoculars rather large, in a single series, undivided; adult males black above with a light spot

on each scale .... *jarrovii jarrovii* (p. 196)

Dorsal scales less than 40; supraoculars in 2 rows or, generally, at least 1 divided; adult males not as described 10

10. Tail very brightly banded toward tip; supraoculars generally in 2 regular rows; median head scales (especially the frontal) usually divided irregularly; (Fig. 76); inner row of sublabials rarely terminating anterior to suture between second and third infralabials; a broad light band across neck behind occiput; ground color reddish .... *poinsettii* (p. 198)

Tail dimly banded; supraoculars large, irregular, 1 or 2 divided; median head scales not usually subdivided (Fig. 77); inner row of sublabials usually terminating anterior to suture between second and third infralabials; no postoccipital light band; ground color bluish .... *cyanogenys* (p. 201)

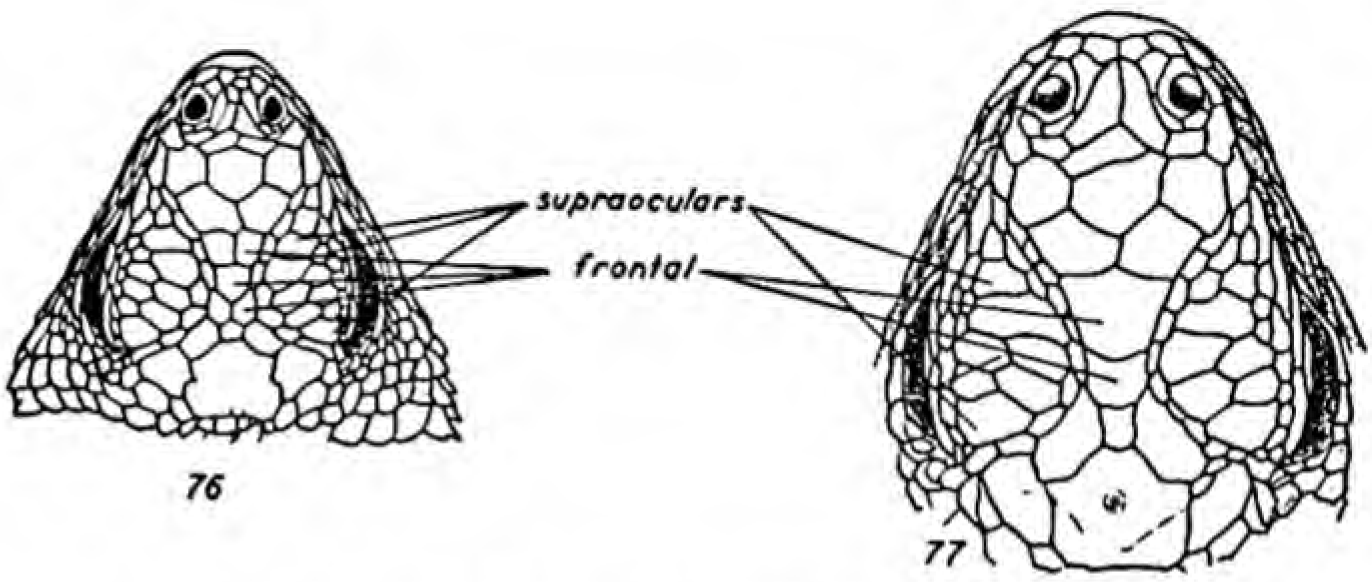


FIG. 76. *Sceloporus poinsettii,* top of head. From Smith.
FIG. 77. *Sceloporus cyanogenys,* top of head. From Smith.

11. Scales on posterior surface of thigh very small, granular, not overlapping 12

Scales on posterior surface of thigh larger, overlapping, keeled ... 15

12. Lateral nuchal scales much smaller than, and well differentiated from, dorsal nuchal scales (as in Fig. 78); scales of lateral row of dorsal nuchals enlarged, strongly keeled, and mucronate; larger, reaching 71 mm. (2¾ in.) snout to vent; gular region bluish in males, not reticulated .... *grammicus disparilis* (p. 193)

Not so; maximum snout-vent length 65 mm.; gular region never with 2 posterolateral blue spots, but usually reticulated 13

13. Dorsal scales 52 or less; dorsolateral light stripes usually very distinct .... *graciosus graciosus* (p. 248)

Dorsal scales 53 or more; dorsolateral light stripes usually indistinct or absent 14

14. Adult males with ventrolateral blue patches separated by a whitish midventral area of considerable width; blue on undersurface of body not confluent with blue of throat; females less dusky below .... *graciosus gracilis* (p. 251)

Adult males with ventrolateral blue patches united across midventral line or separated by a narrow whitish interval; blue or black of belly confluent with that of throat; undersurface of tail and thighs often colored .... *graciosus vandenburgianus* (p. 254)

15. Dorsal scales 33 or less 16
Dorsal scales over 33 17

16. Posterior surface of thigh nearly immaculate; dorsolateral light lines distinct and dorsal bars nearly or quite absent in adult males; dorsal scales 28 to 33, average 30; supraoculars large .... *olivaceus* (p. 204)

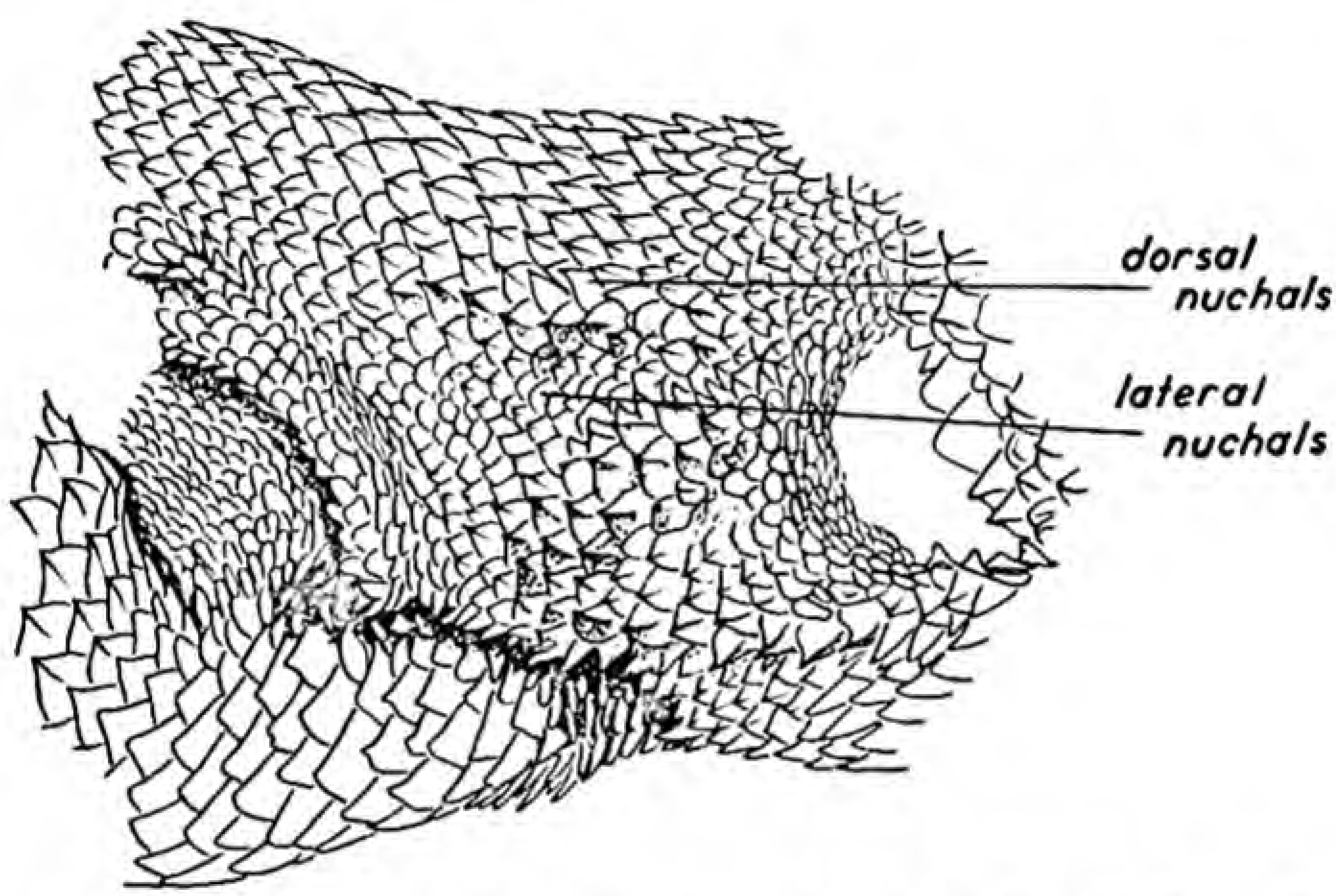


FIG. 78. *Sceloporus grammicus microlepitodus*, side of neck. From Smith.

Posterior surface of thigh with a broad, longitudinal, dark line; no dorsolateral light lines but crossbars on back visible in adult males; dorsal scales 31 to 40, average 34; supraoculars smaller .... *undulatus undulatus* (p. 214)

17. Scales on posterior surface of thigh abruptly differentiated from dorsal scales of same member, median posterior scales not distinctly larger than adjacent lateral scales 18
Scales on posterior surface of thigh gradually merging with larger dorsal scales of same member, at least the median posterior scales distinctly larger than the adjacent lateral posterior scales 21

18. Labial region, chin, and throat crossed by irregular, diagonal, dark lines radiating from the gular region; frontoparietals often in contact with enlarged supraoculars .... *occidentalis becki* (p. 239)
Labial region, chin, and throat not crossed by radiating dark and light lines or bands; frontoparietal plate very rarely in contact with enlarged supraoculars 19

19. Blue belly patches not confluent with throat patches and separated from each other by a lighter or darker midventral band 20

Blue belly patches confluent with throat patches and not separated from each other by a lighter or darker midventral band; ventral surfaces deep blue throughout .... *occidentalis taylori* (p. 244)

20. Blue of throat in males in paired lateral patches (blue widest laterally or separated by median white stripe) which may merge medially in older specimens; under parts very light in color or speckled with darker scales .... *occidentalis occidentalis* (p. 236)

    Blue of throat in males a central patch, never divided; under parts often gray or black .... *occidentalis biseriatus* (p. 241)

21. First canthal generally in contact with lorilabials, sometimes fused with subnasal; dorsal scales 36 to 45; interparietal very large in adults; lateral dark stripes distinct, dorsal pattern indistinct *woodi* (p. 246)

    First canthal rarely in contact with lorilabials; dorsal scales variable; interparietal smaller; no distinct lateral dark stripes 22

22. Dorsal scales generally 37 or less 23

    Dorsal scales generally 38 or more 24

23. Males lacking belly patches .... *undulatus virgatus* (p. 234)

    Males with broad, lateral, belly patches .... *undulatus undulatus* (p. 214)

24. Dorsal scales 45 or more .... *undulatus elongatus* (p. 220)

    Dorsal scales 44 or less 25

25. Males without lateral belly patches; dorsolateral and lateral light stripes very distinct .... *undulatus virgatus* (p. 234)

    Males with lateral belly patches 26

26. Males without gular patches; femoral pores 14 or less; dorsolateral light stripes distinct in both sexes .... *undulatus garmani* (p. 228)

    Males with gular patches 27

27. Females with lateral belly patches; femoral pores 16 or more (75 per cent) .... *undulatus tristichus* (p. 231)

    Females without lateral belly patches 28

28. Dorsolateral light stripes distinct in males; dorsal crossbars reduced in males, confined to areas between dorsolateral light stripes; gular region with 2 dark patches posteriorly, not extending over entire throat; femoral pores 16 or more (70 per cent) .... *undulatus consobrinus* (p. 217)

    Dorsolateral light stripes indistinct in males; dorsal crossbars extending completely across back when visible; gular region almost entirely black in adult males; femoral pores 15 or less (81 per cent) .... *undulatus hyacinthinus* (p. 222)

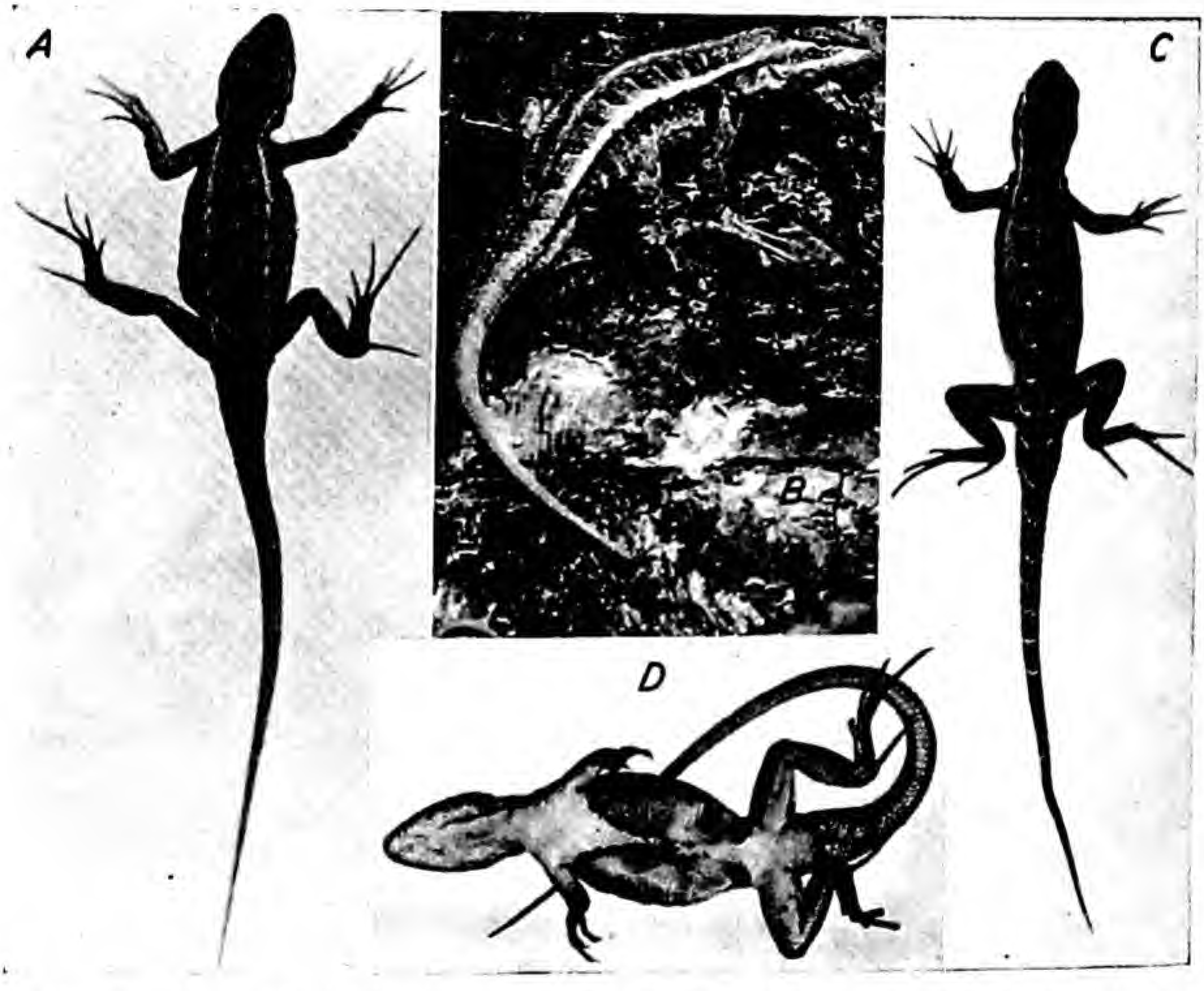
The Variabilis Group

Nine forms belong to this group, which barely enters the United States in extreme southern Texas. The peculiar characteristics of the group are the small size and the presence of a postfemoral dermal pocket. Some of the most distinctive species of the whole genus belong to this group. All are egg layers.

Texan Rose-bellied Lizard *Sceloporus variabilis marmoratus* Hallowell (Fig. 74, p. 181; Pl. 36)

Range. Dallas, Texas, south to Ciudad Victoria, Tamaulipas, and westward about to Long. 100° W. Type locality—San Antonio, Texas. (Map 10, p. 491.)

Size. The largest specimen recorded, a male, measured 52.5 mm. (2⅛ in.) snout to vent; the largest female measured a little less, 49.5 mm. (about 2 in.) snout to vent.



Pl. 36. *Sceloporus variabilis marmoratus.* A, San Antonio, Texas; male. B, San Antonio, Texas; male. Gloyd photograph. C, Edinburg, Texas; female. D, same locality; male.

Color. General ground color olive brown (females) to buffy brown (males); a dorsolateral light line on each side of the body, originating at the posterior corner of the eye and terminating at the base of the tail, from one and one-half to two and two half scale rows wide; between these light lines, two series of 9 or 10 auburn-colored spots, light-bordered posteriorly, the two series separated medially by a faint light line about two scale rows wide; sides of body usually with obscure, narrow, dark bars, their inner ends coincident in position with the corresponding bars on the back; males with a more or less evident brown band on each side of the body below dorsolateral light

lines; a dark spot in the axilla (coincident with blue borders of lateral abdominal marks in males), extending over the shoulder a short distance in front of the arm, interrupted by a white band passing dorsally from the arm; this spot variable in size and intensity of color, usually less distinct and smaller in females; limbs with narrow light and broad dark bars, usually more distinct on the shank and posterior surface of the lower foreleg, occasionally quite indistinct; posterior surface of thigh with 2 irregular dark lines separated from each other by a broader white line; tail with a series of narrow chevron-shaped bars. Males with broad lateral abdominal areas pink in color, with dark blue borders rather broad anteriorly and posteriorly and narrowly separated from each other medially; gular region faintly mottled in males; ventral surfaces otherwise cream or white.

Scalation. The dorsal scales are rather small numbering 58 to 69, average 64, from occiput to base of tail. The femoral pores vary from 10 to 14. All the dorsal head scales are rugose or keeled. A small pocket, the postfemoral pocket, is present in the skin at the junction of the base of the tail with the posterior surface of the thigh (Fig. 75). The scales on the sides of the body are almost equal in size to the dorsals.

Recognition Characters. The postfemoral pocket is possessed by no other species of this genus in the United States, and the only lizard species of other genera that have the pocket also have a granular fold across the throat. The pink belly patches are unique among United States lizards.

Habitat. The northern rose-bellied lizard is typically found in somewhat dry regions where it frequents the limbs of mesquite and similar scrubby trees and bushes. Rarely do specimens occur on limestone bluffs or cacti. They are usually shy and wary creatures difficult to collect.

Habits. The eggs are usually 4 in number, laid in earth and dry humus at the bases of small trees and under rotting logs. "They are somewhat similar to those of other small species of Sceloporus but they are rather more slender, proportionately, and with the ends almost pointed. The average size is about 15 by 6½ mm" (Strecker and Johnson).

Problems. There is a questionable record of the occurrence of this species near El Paso, Texas. This is a locality far removed from others recorded for the race and needs corroboration.

References. Smith, 1939, pp. 272–278 (*gen. lit.*); Strecker and Johnson, in Strecker and Williams, 1935, p. 20 (*Tex.*).

The Merriami Group

The only two forms of the genus belonging to this group are found in the Big Bend region of southern Texas. No definite record of the occurrence of either form in Mexico is yet known. The most distinctive features are the

granular lateral scales and the rudimentary gular fold which is visible in front of the shoulders.

Merriam's Canyon Lizard *Sceloporus merriami merriami* Stejneger (Pl. 37)

Range. The Rio Grande Valley in the Great Bend, from southeastern Val Verde County, Texas, to western Brewster County. Type locality—East Painted Cave, near the mouth of the Pecos River, Texas. (Map 10, p. 491.)

Size. A small species, maximum snout-vent measurement about 58 mm. (2¼ in.); tail about 1⅓ to 1⅘ times as long as head and body.

Color. General dorsal ground color light gray to blue-gray; a series of 10 to 11 small, indistinctly outlined spots on either side of middorsal line on body, the spots becoming gradually larger posteriorly; numerous scattered pale blue and white flecks on body and tail, fewer on limbs; head pale brown; a pair of small, brown spots frequently present at posterior edges of parietal, one to each side; limbs and tail indistinctly banded; toes with rather indistinct bands.

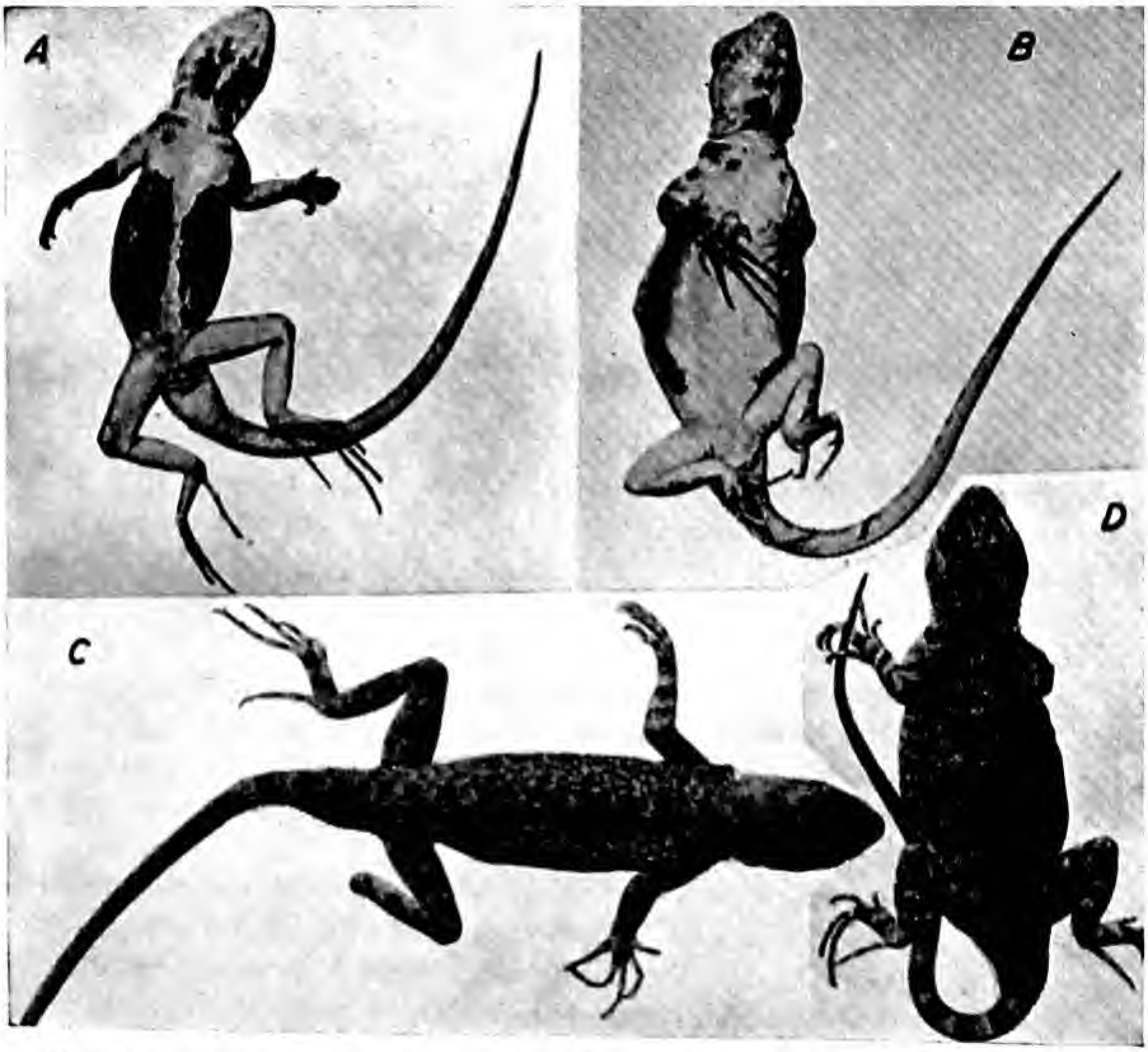
Ventral surfaces of abdomen with deep vinaceous lavender on sides, bordered medially and posteriorly by a broad, dark blue band, wider posteriorly near groin; these borders rarely confluent medially; rarely, in large males, these borders continue anteriorly across chest to gular fold region; a black spot on shoulder, occasionally passing ventrally onto chest, there becoming dark blue; frequently scattered dark blue spots on ventral surface of thigh and on chest; ventral surface of tail and, frequently, chest, a narrow median ventral line and ventral surfaces of thigh, all pale blue; occasionally ventral surface of tail with faint darker bands; posterior part of gular region with 2 rather large dark blue spots, frequently preceded by 1 or 2 pairs of smaller spots; these spots connected with pale blue bands crossing upon labial region; upper labial region with faint brown bands, the one below the middle of the eye most distinct.

Females essentially similar to males in dorsal coloration. Ventral surface of abdomen immaculate, save a dark blue, elongate spot at extreme posterolateral part (comparable to posterolateral markings on abdomen in males); occasionally the spot as large as in small males, and the median dark blue border present; spots on throat similar to those in males, but less distinct; ventral surfaces otherwise usually white or cream.

Scalation. Dorsal scales rather small, 53 to 70, average 63; ventral scales 77 to 90, average 82; scales around middle of body 86 to 120, average 100; femoral pores 22 to 30, average 26; femoral pore series of the two sides in contact medially or separated by 1 to 3 scales; lateral scales very small, granular; no postfemoral pocket; frontoparietals usually single on each side, frequently in contact medially; anterior section of frontal rarely divided longitudinally; an-

terior scales of outer row of sublabials wedged between first infralabial and first postmental; postanal scales enlarged in males.

Recognition Characters. The absence of a gular fold, the presence of the ear opening, the very small size of the dorsal scales, the absence of a postfemoral pocket, and the granular lateral scales will distinguish this species from any



Pl. 37. *Sceloporus merriami merriami*. Devil's River, Texas. A, C, male; B, D, female.

other found in the same area. From its related subspecies, Merriam's mountain lizard, this may be distinguished by numerous characters, among which may be mentioned the indistinct, or missing, subcaudal bands; the confinement of the ventral throat bars to the middle of the throat, where they are usually separate and not so distinct as in the other form; the entire anterior section of the frontal; the partial separation of the first infralabial and first postmental; the smooth head scales. In the other subspecies the subcaudal bands are very distinct; the throat bars extend to the labial region and are fused medially; the anterior section of the frontal is usually longitudinally divided;

and the first infralabial and first postmental are fully in contact. There are other differences listed by Smith.

Habitat. The race appears to be restricted to desert canyons at low elevations where specimens occur on the side walls.

Habits. These are not particularly shy lizards; with some care they can be caught by hand. Many lack toes and tails. They frequently rest about 4 to 6 feet above the bottom of the canyons. They perform bobbing exercises like many other iguanids. Two eggs measuring 12 x 7 and 11 x 6 mm. were observed in one female collected on July 1.

Problems. The life history of this interesting lizard is practically unknown. Presumably it lays eggs, but it may be ovoviviparous.

References. Smith, 1937, p. 86 (*Tex.*); *idem,* 1939, pp. 285–289, diagnoses, comparisons, range (*gen. lit.*); Wright and Wright, 1927, pp. 57–64, pls. 1–3, natural history (*Tex.*).

Merriam's Mountain Lizard *Sceloporus merriami annulatus* Smith (Pl. 38)

Range. Southern and central Brewster County, Texas, in mountains. Type locality—east slope of the Chisos Mountains, Brewster County, Texas. (Map 10, p. 491.)

Size. A small species, maximum snout-vent measurement about 51 mm.; tail about 1⅓ to 1⅘ times as long as head and body.

Color. As in Merriam's canyon lizard except that adult males have the dark blue median borders of lateral abdominal marks confluent, covering middle of abdomen and extending over most of ventral surface of thighs; broad, dark blue, convergent bands on throat; blue tail bands confluent on ventral surface of tail, or nearly so, in both males and females.

Scalation. Head scales slightly but distinctly rugose; frontoparietals usually divided into 2 or 3 scales on each side, rarely separated medially; anterior section of frontal usually longitudinally divided; prefrontals rarely in contact medially; outer row of sublabials rarely terminating anteriorly between first infralabial and first postmental, but usually posterior to them; dorsal scales 47 to 62, average 53, from occiput to base of tail; scales around middle of body 85 to 101, average 92; femoral pores 19 to 28, average 24; femoral pore series separated from each other medially by 1 to 5 scales; no postfemoral pocket.

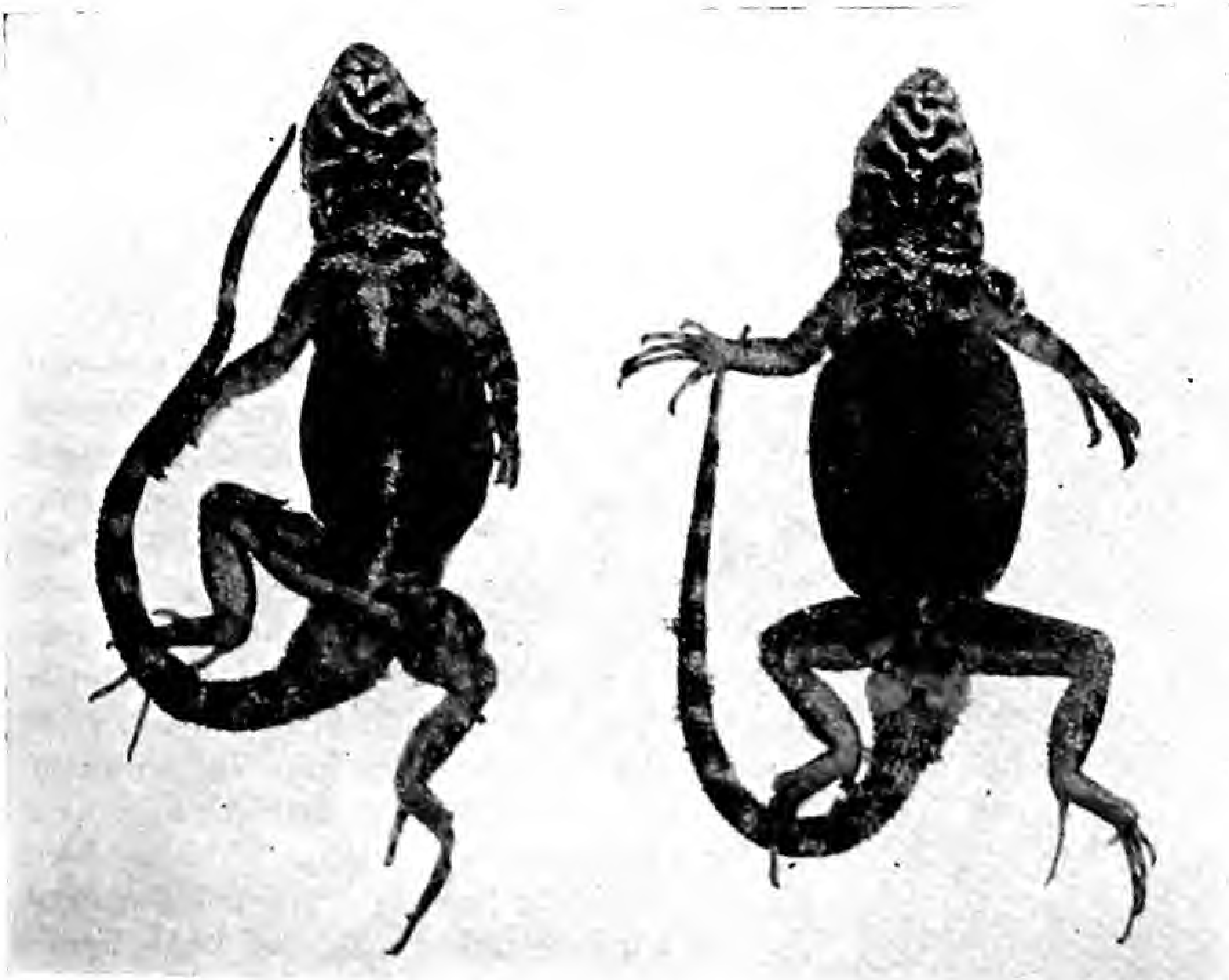
Recognition Characters. See discussion of Merriam's canyon lizard.

Habitat. Restricted to the southern mountains of the Big Bend in a rock habitat.

Habits. Not recorded.

Problems. The natural history is unknown. The distribution of these two closely related forms and their curious restriction suggest a problem for study in the field.

Reference. Smith, 1937, pp. 83–86, description, range, comparisons (*Tex.*).



Pl. 38. *Sceloporus merriami annulatus.* Glenn Spring, Texas; male. Smith photograph.

The Scalaris Group

This is for the most part a group of high-mountain lizards. Some of the species give birth to their young, others lay eggs. The chief characteristics are the presence of only 2 postrostrals, or none; the near or complete meeting medially of the femoral pore series; the granular scales on posterior surface of thigh; the small size; and, most conspicuous, the tendency of the lateral scales to be arranged in longitudinal rows parallel to the body axis.

Bunch Grass Lizard *Sceloporus scalaris slevini* Smith
(Pl. 39)

Range. Southern Arizona at high elevations, south to northern Durango, west into eastern Sonora, and east to Nuevo León. Type locality—Miller Peak, Huachuca Mountains, Arizona. (Map 10, p. 491.)

Size. A small species, maximum snout-vent measurement about 61 mm. (2⅜ in.); tail 1¼ to 1⅔ times as long as head and body.

Color. Two color phases occur. In one phase the dorsal pattern is completely lacking; the back is dark brown to yellow-brown. Usually, however, there is

Pl. 39. *Sceloporus scalaris slevini*. A, Ramsey Canyon, Huachuca Mountains, Arizona; courtesy of J. R. Slevin. B, Miller Peak, Huachuca Mountains. Maas photograph.

a bright dorsal pattern of crescentic blotches and light stripes on a light brown ground color. On each side is a dorsolateral light line running down a single scale row, and separated from its mate by about 7 or 8 scale rows. In this intervening area are two series of about 12 crescentic, blackish-brown spots, a series on either side of the median line. A lateral light line extends from the labial region on the sides of the head through the ear and along the sides of the body onto the front of the hind leg. Between the lateral and dorsolateral light lines, on each side, is a series of crescentic blotches similar to those near the middle of the back. Below the lateral light line is a narrow area of brown, spotted with darker color, in turn bordered by a reddish-brown band. In males, below this band on the sides of the belly, is a blue patch 3 or 4 scales wide extending from axilla to groin. The belly is otherwise unmarked. A conspicuous black spot is present in front of the shoulder, enclosing a bright blue spot. The tail is marked above by a continuous, middorsal, dark brown stripe.

Scalation. Dorsal scales 37 to 46, average 42; scales around middle of body 38 to 45, average 41; ventral scales 35 to 45, average 41; femoral pores 12 to 18, average 14, the two series separated by not more than 2 scales, or in contact medially; scales on posterior surface of hind legs granular; no postfemoral pocket; scales on side of body forming longitudinal series paralleling the series of dorsal scales, except perhaps just in front of groin.

Recognition Characters. The absence of a gular fold and the rather small size of the body and of the dorsal scales distinguish this from all other lizards occurring in the same general area with the exception of the striped plateau lizard. From this, and from all of the many other *Sceloporus* species known from the United States, this peculiar species is distinguished by the fact that the lateral scales, which are not much smaller than the dorsal scales, are in rows parallel to those in the back instead of in oblique rows that extend upward (medially) in a posterior direction. All

other species of the genus in the United States have the lateral scales in oblique rows.

Habitat. The normal habitat of the race seems to be in clumps of grass, where it is found on Miller Peak and presumably also on the other high peaks in the mountains of southeastern Arizona from which it is known. This is a habitat exactly like that of very common close relatives of this race that are widely distributed in Mexico. Gloyd, however, found several under boards in a clearing in a forested part of the Huachucas, not far from the peak, and Kauffeld found one sunning itself on a rock after a rainstorm. The close resemblance of this species to *S. u. virgatus* suggests that the varied field observations may possibly apply in reality to both species.

Habits. This is a shy and elusive species, seemingly spending most of its time hidden in the clumps of tall grass it frequents. Sometimes specimens are seen scurrying between clumps. In spite of the fact that a specimen may be traced to a single clump, the collector usually finds difficulty in locating and extricating it. Once taking refuge in a clump, the lizard remains hidden frequently after a thorough picking and parting of the grass blades. Its ability to disappear in this manner is astounding at times.

Presumably this species bears its young instead of laying eggs; this habit is known for a number of its relatives, although it is not proved for this race.

Problems. The life history of this race is a conspicuous problem. Its relationships with Mexican forms are very puzzling and need study with new material.

References. Gloyd, 1937, pp. 88, 98, 112 (*Ariz.*); Kauffeld, 1943, p. 345 (*Ariz.*); Smith, 1939, pp. 343–344, description, range, localities, relationships (*gen. lit.*); Van Denburgh, 1922, pp. 268–273, pl. 19, description, habits (*gen. lit.*).

The Grammicus Group

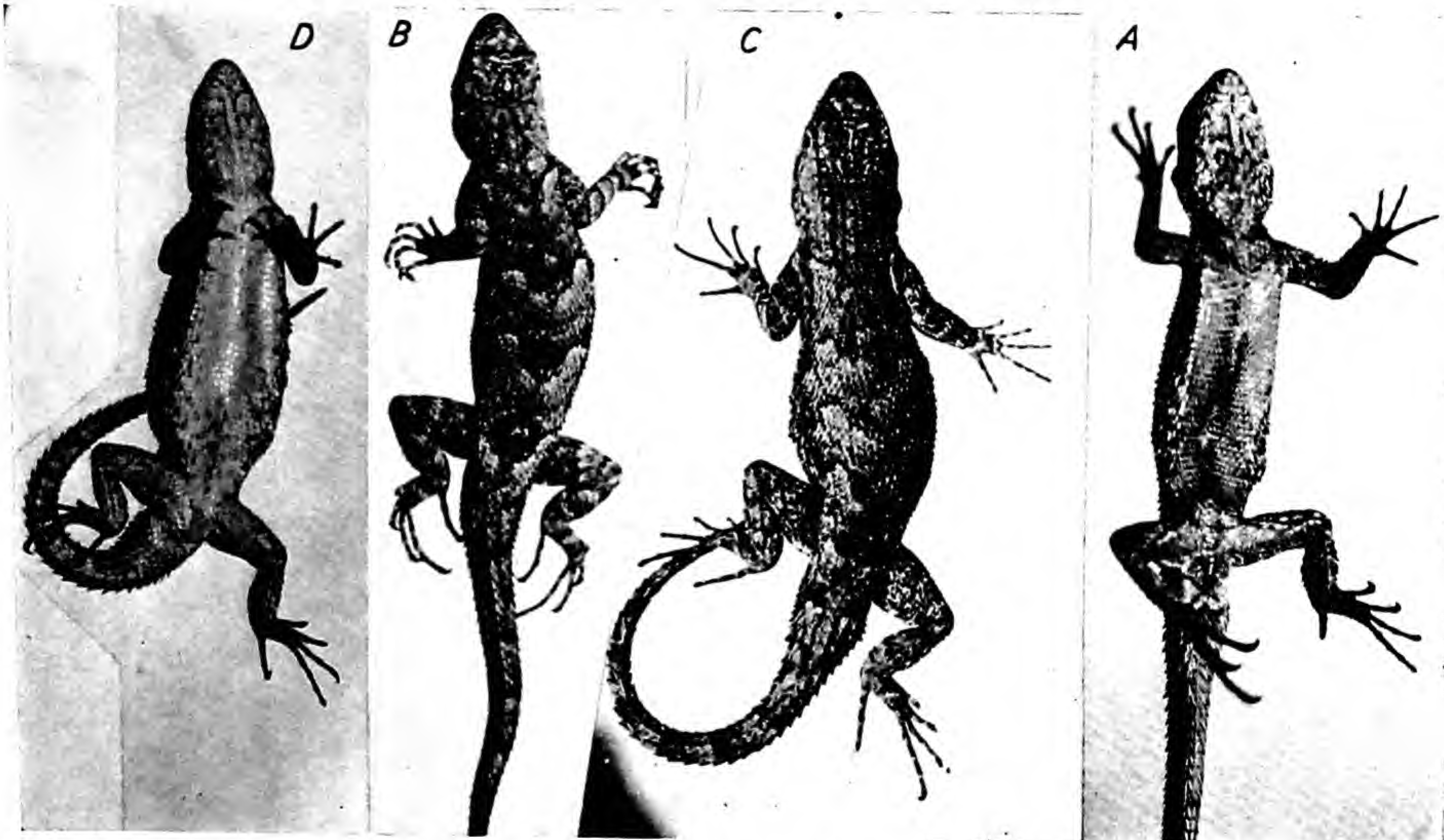
This is a puzzling group of four forms, barely entering the limits of the United States. All forms are of moderate size, have granular posterior thigh scales, and give birth to their young.

Mesquite Lizard *Sceloporus grammicus disparilis* Stejneger (Pl. 40)

Range. Northern Hidalgo and Guanajuato in Mexico, northward to northwestern Chihuahua and extreme southern Texas. Type locality—Lomita Ranch, six miles north of Hidalgo, Texas. (Map 11, p. 492.)

Size. A more or less flattened species, of moderate size; maximum snout-vent measurement 71 mm. (2¾ in.).

Color. In females the ground color is light gray; 2 narrow, parallel, black lines on nape, extending toward middle of back; a series of 4 or 5 narrow, black, undulate bars on each side of back, those of the two sides coinciding



Pl. 40. *Sceloporus grammicus disparilis.* Edinburg, Texas. A, C, male; B, D, female.

in relative position or not; lower foreleg with very distinct black bars; hind leg irregularly barred; tail with narrow, black bars not sharply defined; head with numerous narrow, black lines; belly whitish, unspotted save for a few black flecks on throat and sides of abdomen.

Adult males lose almost all trace of the dorsal markings; the only distinct dorsal mark is the nearly vertical one in front of arm, extending to middorsal region; it is expanded somewhat in front of the arm insertion. Throat finely mottled or stippled with black; central region of throat usually flesh color, sometimes pale blue; a broad or narrow black line across throat sometimes present; sides of belly pale blue (appears flesh color in preserved specimens), bordered medially by a short, narrow, black border; chest somewhat mottled in some specimens; remainder of ventral surfaces whitish.

Scalation. Dorsal scales 52 to 74, average 62; scales around middle of body 50 to 71, average 62; ventral scales 49 to 65, average 58; femoral pores 12 to 20, average 15; lateral nuchal scales abruptly differentiated from dorsal nuchal scales (as shown in Fig. 78); no postfemoral pocket. A pair of enlarged postanal scales in males.

Recognition Characters. Lizards of generally similar form which might be confused with this, within the area where it occurs, can be distinguished by having a granular gular (ventral throat) fold, or a postfemoral pocket, or larger dorsal scales that number less than 52, or by not having lateral and dorsal nuchal scales which differ sharply from each other in size.

Habitat. These lizards are confined exclusively to the small, scrubby trees typical of extreme southern Texas. Mesquite trees are favorite haunts.

Habits. Their movements are very quiet, unlike some noisy, arboreal *Sceloporus* species, and unobtrusive. At first sight of danger, when the intruder is yet far away, they take refuge in the higher main branches and persistently keep themselves on the side opposite the intruder. These tactics are rendered the more effective by their beautifully protective pattern and coloration. So completely do they effect concealment that, even though searching diligently for them, a collector may never observe a specimen. They are best hunted by two persons at a time, one beating the tree, the other watching on the other side.

The young are born in early April and number 3 to 12 in each litter from a female. This is one of the few live-bearing lizards of the country. Mating appears to occur in October; at least courting has been observed at that time. The embryos may develop in 5 or 6 months. "In courting the males bobbed up and down on their forelegs and expanded the throat membrane in a fan shape" (Mulaik).

Problems. The chief taxonomic problem concerning this race lies outside the boundaries of the United States, in Mexico, but needs study very much.

References. Mulaik, 1936, p. 72, life history (*Tex.*); Smith, 1939, pp. 191–197, description, range (*gen. lit.*).

The Torquatus Group

The largest group of the genus is this, containing twenty-two forms. It is widely distributed, from the Yucatán Peninsula northward to southern central United States. The distinctive features are the large size and the conspicuous, light-bordered, neck collar. All species, so far as known, give birth to their young.

The group has also been known as the *poinsettii* group.

Yarrow's Scaly Lizard *Sceloporus jarrovii jarrovii* Cope
(Pl. 41)

Range. Central Arizona east to western New Mexico and south in Mexico through Chihuahua and western Sonora to extreme western Zacatecas and extreme northern Nayarit. Type locality—southern Arizona. (Map 9, p. 491.)

Size. Maximum snout-vent length about 90 mm. (3½ in.), tail slightly longer than, to 1½ times as long as, body.

Color. In adult males the dorsal ground color is black, brilliantly marked with a light spot in the center of nearly every scale; a black collar on neck bordered posteriorly by a narrow, whitish band which may not reach middle of back; a few longitudinal light stripes on sides of neck and head; tail with narrow dark bands, becoming black at tip. Ventral surfaces mostly blue and black, or gray; throat and sides of abdomen dark blue, middle of abdomen lighter blue or gray; chest and groin gray, sometimes black.

Females show few of these bright markings, but are dull, irregularly spotted and speckled gray above, whitish below; the neck collar is present, however. In young specimens a dark lateral line, poorly defined, may be evident.

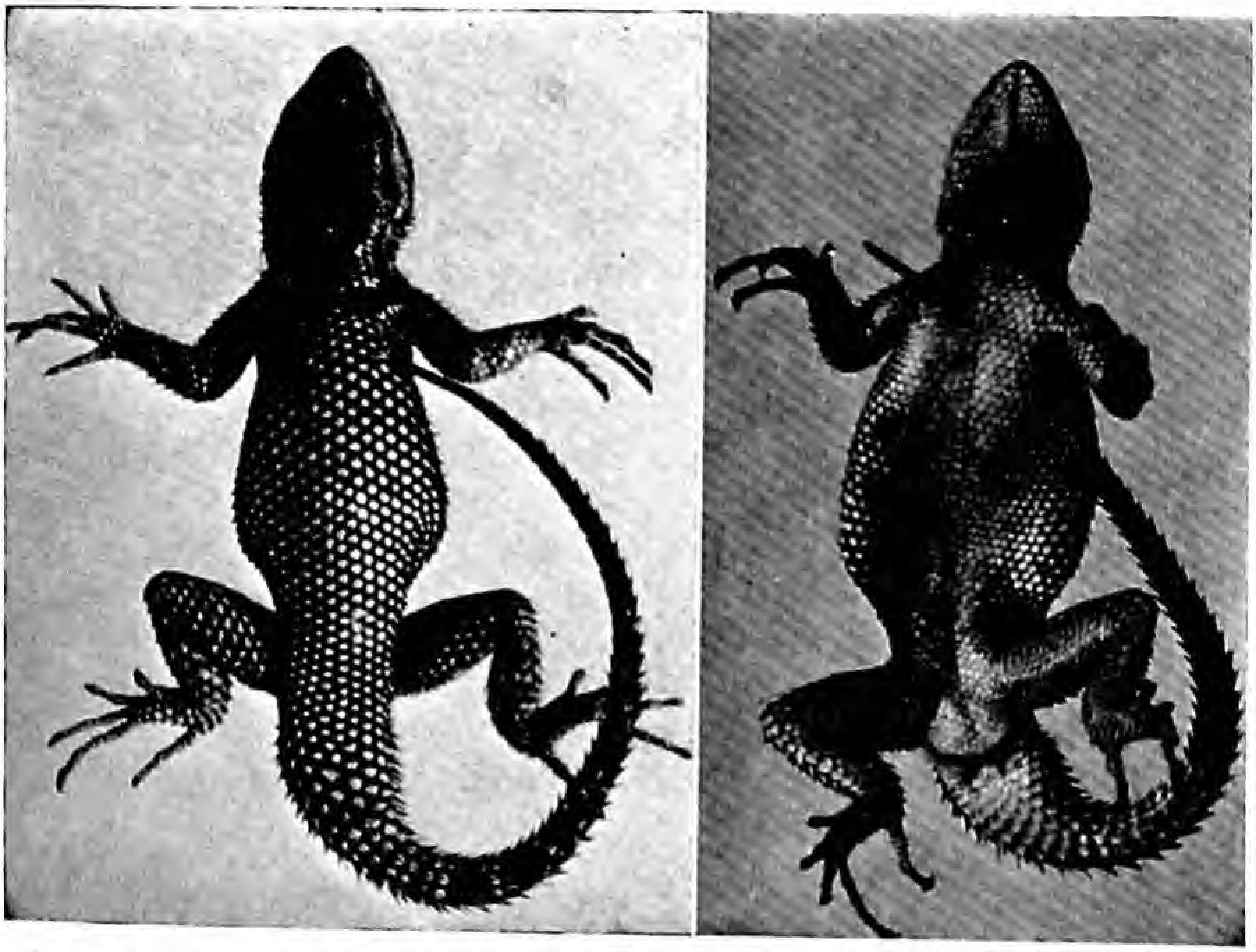
Scalation. Dorsal scales 38 to 46, average about 43; femoral pores 13 to 18, average 15. Supraocular scales generally in a single series, but not of large size.

Recognition Characters. The black collar about the neck, the absence of the gular fold, and the rather large size of the dorsal scales separate this species from any other with which it might be confounded, in the area where it occurs, except the red scaly lizard. The last can be distinguished from Yarrow's lizard by the very distinct, black, tail bands, the broad light borders on the black neck collar, the 2 series of enlarged supraoculars, and many other features of pattern and scalation.

Habitat. This is a mountain lizard, ranging from about 5000 to 10,000 feet in elevation. Its preferred habitat is boulders in the forested oak and conifer belts. In the same zone it occurs "in almost every type of habitat: on the walls and ledges of cliffs, in crevices, on rocks along the brooks, in rock slides, on trees, fallen logs, abandoned buildings, in heaps of debris and old machinery parts, beneath piles of boards, and on the ground" (Gloyd).

Habits. These lizards emerge on warm days, sunning themselves on the

objects under which they hide during the night. They are seen in sunny places and are very conspicuous because of the brilliant bluish color of the older individuals. The color varies according to temperature; when it is cool they may be extremely dark, even the collar becoming indistinguishable. The ability to change color is more marked in males than females, and in older animals.



Pl. 41. *Sceloporus jarrovii jarrovii.* Hamburg Mine, Huachuca Mountains, Arizona, male.

Because of their lack of timidity and great curiosity these lizards were easily captured by means of a thread noose at the end of a slender stick. When approached with the noose some seized the thread and chewed it savagely, and although somewhat alarmed by attempts to drop the noose over their heads, did not become frightened enough to flee to safety at once but permitted the collector to try again. Those of larger size were more difficult to approach and usually scampered out of reach up the canon wall if the first trial with the loop was successful.

On July 30, 1930, in a partly dismantled shed in Ash Cañon, Huachuca Mountains, I watched two approximately half grown *S. jarrovii*, one somewhat larger than the other, fighting or pretending to fight. They sprang at each other with open mouths but neither seemed to receive much, if any, injury. After one of these clashes they separated, faced each other, spread their throat fans widely, and each bobbed rapidly up and down, raising and lowering its body with its forelegs. The larger apparently tired of this activity and turned to other pursuits while the smaller menacingly followed with open mouth.

Remains of this species were found in the excrement of *Crotalus triseriatus pricei* Van Denburgh (Little Spotted Rattlesnake) in the Chiricahua Mountains (Gloyd).

Kauffeld states that both the above mentioned species and *C. lepidus klauberi* readily eat these lizards in captivity.

In the Santa Rita Mountains MacCoy found the species most abundant from the summit of Mount Wrightson at 9432 feet down to about 8400 feet. Below this level it became scarce as the vegetation became abundant. "At the top of the mountain the greatest number of lizards was observed between 1 and 2 o'clock. Late in the afternoon as the eastern side of the mountain became shady, most of the lizards disappeared from this region, but were seen later on the sunny, western side." One female with 2 eggs containing well-developed embryos was noted. The stomach contents indicated an insect diet; ants and beetles predominated. A half-inch piece of tail of the same species was found in one stomach, suggesting a cannibalistic habit; this is further borne out by the many broken-tailed young specimens observed.

Various authors have noticed the prolific infestation of specimens with mites.

Problems. Oddly enough the life history of this very conspicuous species, long known in the Southwest, is little known. It should be very interesting, for almost certainly the species is ovoviviparous, giving birth to young rather than laying eggs. Even this is not definitely known. A chronological comparison of the events in the life history of some live-bearing species of *Sceloporus,* such as this, with some not distantly related egg-laying species, should be extremely interesting.

References. Gloyd, 1937, pp. 88, 98, 110–112, fig. 13 (habits, habitat (*Ariz.*); Kauffeld, 1943, p. 345 (*Ariz.*); MacCoy, 1932, pp. 19–21, habits, habitat (*Ariz.*); Smith, 1938, pp. 624–631, pl. 47, description, range (*gen. lit.*); Van Denburgh, 1922, pp. 321–326, pl. 26, description, range (*gen. lit.*).

Red Scaly Lizard *Sceloporus poinsettii* Baird and Girard

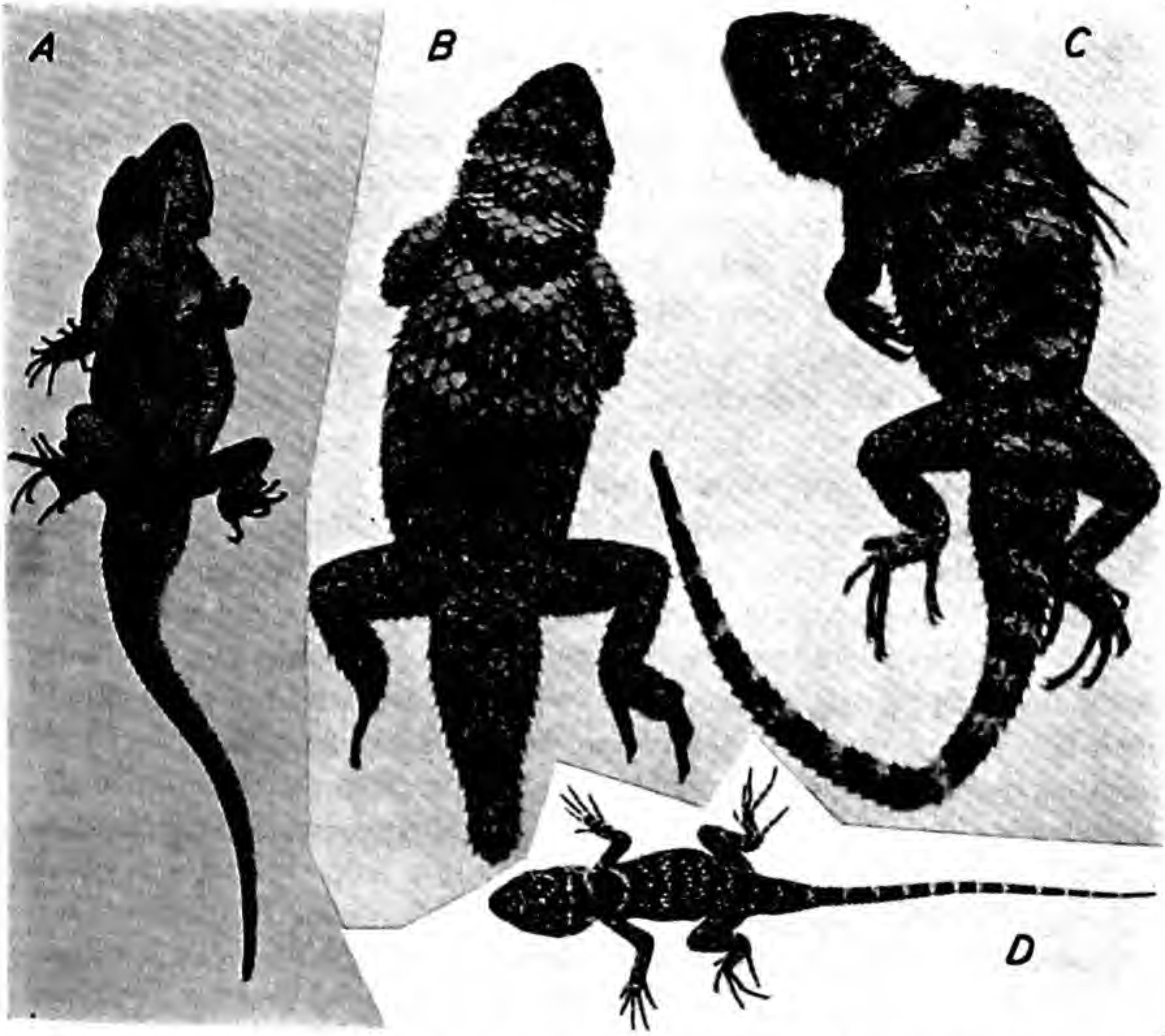
(Fig. 76, p. 183; Pl. 42)

Range. Southern New Mexico east to central Texas, and south in Mexico through Chihuahua, Coahuila, and western Nuevo León to southern Durango. Type locality—Rio San Pedro of the Rio Grande del Norte, and the province of Sonora. (Map 12, p. 492.)

Size. A rather large species, maximum snout-vent length about 123 mm. (4⅝ in.); tail about 1⅓ to 1⅔ times as long as head and body.

Color. Dorsal surfaces olive gray to reddish. A broad, black, neck collar covering 2½ or 3 scale lengths, bordered on either side by a broad, light band

covering 1 or 2 scale lengths. Either 4 or 5 large dark blotches on middle of back, separated from each other by narrow light spaces, darkest medially, fading laterally and disappearing in dorsolateral region; sometimes a dark streak down the edges of scale rows. Tail banded, the bands on distal part extremely dark and well defined, visible on the subcaudal surface. Sometimes a light band across neck between nuchal collar and head.



Pl. 42. *Sceloporus poinsettii.* A, Medina Lake, Texas; female. B, C, same locality; male? D, Helotes, Texas; young.

Throat in males a uniform cerulean blue; black nuchal collar largely interrupted ventrally, but continuous in a narrow zone in the gular region; chest white, sometimes flecked with black; middle of belly white; sides of belly pale to cerulean blue, bordered medially by a broad black area expanding posteriorly in groin and on thighs, anteriorly disappearing a short distance posterior to axilla; limbs cream below; preanal region cream or, sometimes, bluish.

In females the gular region is mottled with gray, or has a gray suffusion; a median pair of longitudinal lines, enclosing a narrow light line, may be pres-

ent; the ventral surfaces otherwise are immaculate, save for certain large specimens in which the lateral belly patches characteristic of males may be dimly indicated.

Scalation. Dorsal scales 31 to 41, average 36, from occiput to base of tail, nearly smooth but with 1 or more small, terminal points; supraoculars in 2 complete rows, those of outer row nearly as large as those of inner row; median cephalic scales very irregular; anterior section of frontal usually subdivided into 2 or more scales (Fig. 76;) subocular generally separated from labials by as little as 1 scale at some point along its length; femoral pores 9 to 18, average about 12.

Recognition Characters. The rather large scales and double row of supraoculars distinguish this lizard from all others occurring in the same area, except sometimes the blue scaly lizard, which is very frequently confused with it. These two can be distinguished easily by the bands on the tail, which are very bold and black toward the tip in the red, but poorly defined in the blue, species. There are many other differences in pattern; the red species, as the name implies, is usually reddish in color but never bluish, and the reverse is true of the blue species. The latter lacks distinct crossbands on the back, whereas the former usually has fairly distinct ones. In scale characters, the red species has 2 complete rows of nearly subequal supraoculars, very irregular median head scales, and the subocular generally separated from the labials by a single scale, rather than 2 or 3 scales, at some point; the blue has supraoculars of irregular size and usually only 1 or 2 scales in the outer row, more or less regular (typical) median head scales, and at least 2 complete rows of small scales between the subocular and labials. The two species are widely different, but some experience with them generally seems necessary to enable ready separation of them. Over most of their ranges, however, there is no overlapping; in fact the ranges coincide only in a narrow area in northern Mexico.

Habitat. So far as I am aware this is exclusively a boulder or rock species. It may occur on rock fences as well as on natural piles of boulders and cliffs. In Texas and New Mexico specimens are found in limestone bluffs in considerable numbers.

Habits. Capture of specimens of this species is rather difficult. They are so wary that they slip into ever-near crevices or cracks long before an intruder arrives in the near vicinity unless great care is used to watch long distances—100 or more feet—ahead. Usually I have found specimens most successfully by looking in cracks. Even when discovered in such spots they can be extracted only with much effort unless the rock can be removed.

Murray records a specimen eaten by a rare ring snake, *Lampropeltis alterna.*

The species is ovoviviparous, as are others of this group. One specimen examined contained 10 embryos.

Problems. The life history of this large species should prove very interesting, but few features of it are known.

References. Murray, 1939, pp. 11–12 (*Tex.*); Smith, 1938, pp. 606–617, pl. 51, text figs. 14, 15, description, range, localities (*gen. lit.*); *idem*, 1939, pp. 223–225, fig. 30, diagnosis, additional localities (*gen. lit.*).

Blue Scaly Lizard *Sceloporus cyanogenys* Cope

(Fig. 77, p. 183; Pl. 43)

Range. Southern Texas along the Rio Grande from Devil's River to Starr County, southward in Mexico to central Tamaulipas and central Nuevo León. Type locality—Monterrey, Nuevo León, Mexico. (Map 12, p. 492.)

Size. This is the largest of all *Sceloporus* species, the males reaching a length of at least 141 mm. (5½ in.), the females 130 mm. (5⅛ in.) snout to vent. The tail is about 1½ times as long as the body.

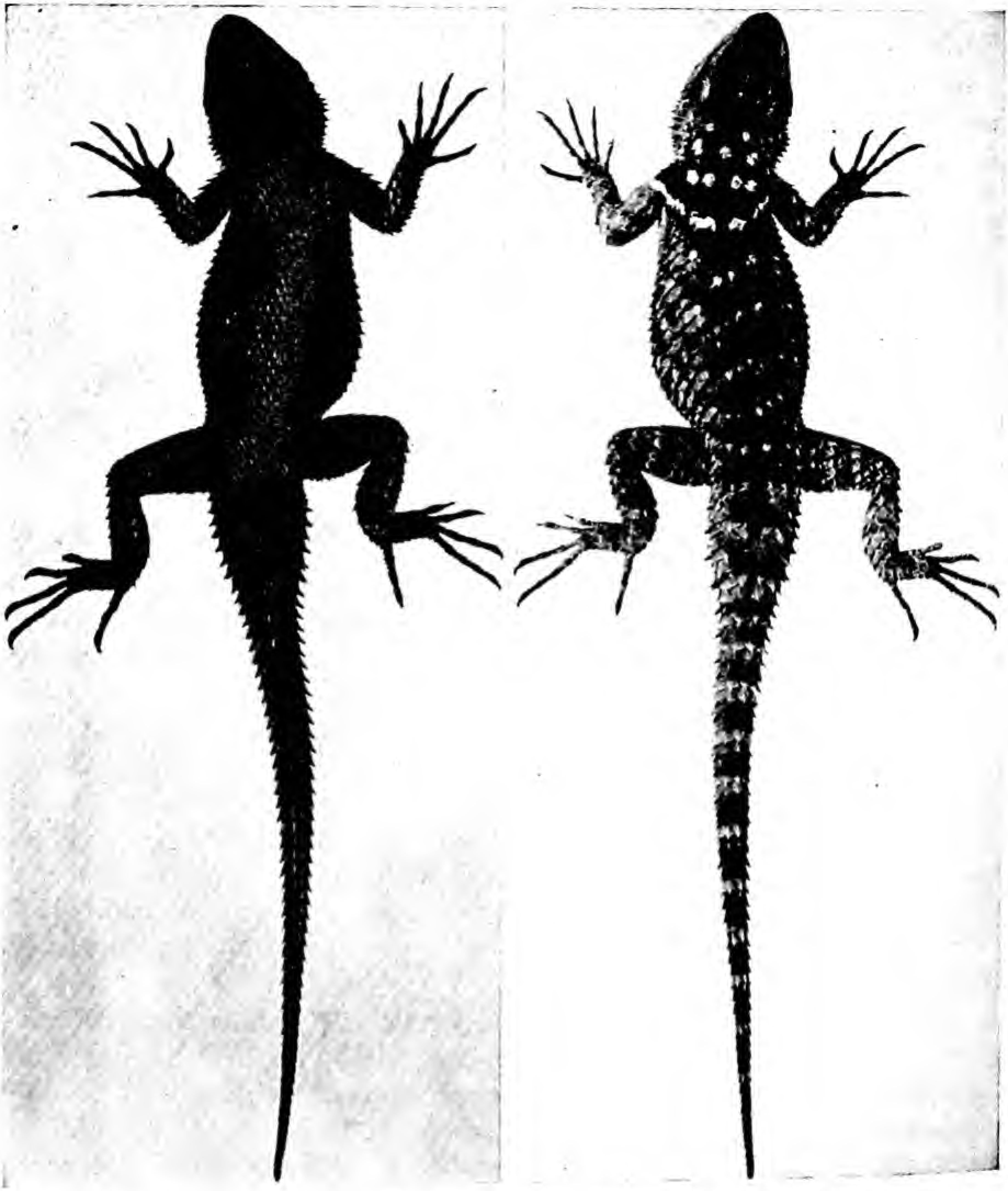
Color. Full-grown males are beautifully colored. They are a brilliant greenish blue above (unless about to shed, or during cold spells), except the head, which is somewhat brownish. Around the posterior part of the neck passes a jet-black collar some 3 scale lengths long, somewhat wider on shoulders and narrower on throat. The black collar has a yellow border behind, sometimes broken in the middle of the back, ending on the shoulder on each side; there is also an incomplete yellow border in front, usually broken in the middle by a black line and not reaching sideways much farther than the level of the ear; a bright blue spot is in the center of the black collar on each shoulder. There are almost no other markings dorsally; a few light flecks, frequently arranged in pairs down the middle of the back, are almost invariably present. There are no distinct markings on the limbs, and the dark bands on the tail are never clear-cut and distinct.

Below, the males have the entire throat and chin pale blue, this color ending posteriorly at the black neck collar. The sides of the belly are pale blue, and in young males the pale blue areas are bordered with a narrow band of darker blue; in older males this band becomes broader and darker, and extends into the groin. The chest may have a bluish suffusion on each side, more or less connecting the blue belly patches with the black neck collar. Otherwise the chest, a broad median band on the belly, and the ventral surfaces of the limbs and tail are white or cream.

Females are darker than males above, and have vague, dark, narrow crossbands on the back. The belly is unmarked. The throat is suffused with gray and has a median, longitudinal, light streak.

The young are marked more or less like the females.

Scalation. The most important features are the fairly large dorsal scales, 32 to 40 from occiput to base of tail, which are rather weakly keeled and strongly



Pl. 43. *Sceloporus cyanogenys.* Rio Grande City, Texas; male. U.S. Fish and Wildlife Service photographs.

pointed only on the sides of the body; the supraoculars are large, but 1 to 3 are usually split into two; there is never a regular, double row of supraoculars, and rarely just a single row; they are completely surrounded by a row of small scales. The median head scales are large and vary but little in number and position (Fig. 77). The preocular is rarely divided; the inner row of sublabials terminate posterior to the suture between the second and third infralabials, and the 2 rows of lorilabials are usually complete below the subocular, seldom

reduced to one at any point below that scale. The femoral pores vary from 12 to 17 on each side.

Recognition Characters. The large size, the blue coloration, the lack of distinct, *black* bands toward tip of tail, the irregular supraoculars and the very regular median head scales will identify and separate this species of lizard from any other. The species most frequently confused with it, the red scaly lizard, has a reddish coloration, black tail crossbands, supraoculars in 2 distinct rows, irregular median head scales, and many other distinctive characters.

Habits and Habitats. Taylor, who first discovered and recorded this species in the United States, says that in the small hills near Rio Grande City, Texas,

> the specimens were extremely numerous; as many as ten or fifteen might be seen at one time running over the face of the outcropping rock which caps the hills. The largest males seemed most wary and would disappear in deep holes in or under the rocks (rather than in cracks and crevices); the larger females and the younger specimens were less wary and instead of disappearing to safety would frequently hide from sight behind a jutting rock and then expose their heads to view a moment later and allow me to approach close enough to kill them with a .22-caliber rifle using small shot shells.
>
> At Arroyo El Tigre, west of Rio Grande City, the species was encountered on the dry earth banks where no rocks were to be found. They took shelter in cracks in the earth.

Specimens have been found in considerable numbers in a pile of steel rails. Near Monterrey, Mexico, they are common on stone fences.

Like other scaly lizards, this species gives birth to the young rather than laying eggs. One female gave birth to 11 young on June 2, at about the time most other United States lizards are laying their eggs.

Problems. As with most other lizards, a good study of life history and habits is much to be desired. This is particularly true of this species because of its peculiar habit of giving birth to its young. Only three other lizards of this genus in the United States have this characteristic.

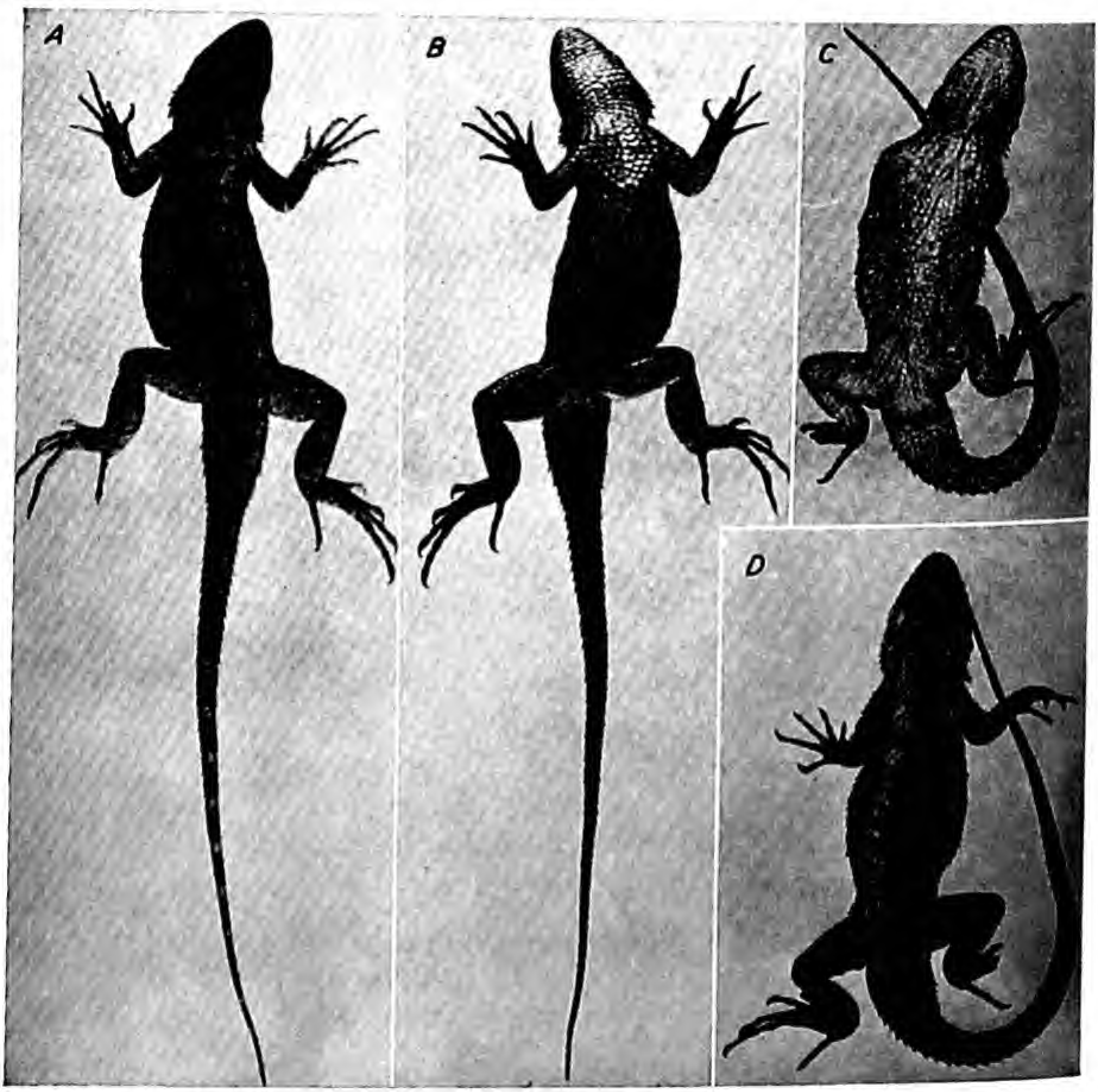
References. Smith, 1938, pp. 599–606, text figs. 13 and 14, pl. 51, fig. 2 (*gen. lit.*); *idem*, 1939, pp. 221–223 (*gen. lit.*); Taylor, 1931, pp. 129–132 (*Tex.*).

The Spinosus Group

This is one of the largest groups, containing some twenty forms, and is distributed from Guatemala to southern central and western United States. All species are large and have large, spiny scales and very large supraoculars. All lay eggs.

Texan Spiny Lizard *Sceloporus olivaceus* Smith
(Pl. 44)

Range. Extreme southern central Oklahoma, southward through central Texas to southern Tamaulipas, central Nuevo León and southeastern Coahuila. Not definitely known west of Long. 101° W. Type locality—Arroyo Los Olmos, 3 miles southwest of Rio Grande City, Starr County, Texas (Map 13, p. 493.)



Pl. 44. *Sceloporus olivaceus.* A, B, Shoal Creek, Austin, Texas; female. U.S. Fish and Wildlife Service photographs. C, D, Helotes, Texas; male

Size. The largest male recorded measured 97.5 mm. (about 3⅞ in.) snout to vent, the largest female 121 mm. (about 4¾ in.). The tail is about 1¾ times as long as the body. The smallest specimens seen measure 29 mm. snout to vent (about 1⅛ in.)

Color. Males are gray and gray-brown above, the head somewhat brownish. A light stripe without distinct edges extends along each side of the back from the neck to the base of the tail, enclosing between them a brown-gray area; latter nearly uniform or with about 9 undulate, dark brown, transverse bars; sometimes the dark bars may penetrate the dorsolateral light streaks and extend upon the sides of the body. Sides almost as dark as back, with irregular, scattered, light flecks; upper edge of lateral dark area forming a more or less continuous stripe extending from neck to base of tail. Tail and limbs dimly barred. Belly white, with some black flecks that tend to form a median longitudinal streak; a narrow, rather short, light blue area on sides of belly, not reaching groin or axilla; these blue areas are not black bordered, and are widely separated from each other medially by 6 or 7 scale rows.

Females can easily be distinguished from males, in dorsal as well as ventral coloration. The broad median dark area always has distinct, broad, transverse bands; the dorsolateral light stripes are not very well defined because the sides of the body are light and have only feeble dark marks. The blue areas on the sides of the belly are lacking in the female.

Scalation. The chief features of the scalation are the large, rather strongly keeled and strongly pointed dorsal scales numbering 28 to 33 from occiput to base of tail (average 30). The supraoculars are quite large, broad, 5 or 6 in number, and are separated from the median head scales and the superciliaries by a single row of scales; the femoral pores number 11 to 16, average 13.3.

Recognition Characters. Within its range no other lizard has large dorsal scales like the Texan spiny lizard except the desert spiny lizard. The last has still larger supraoculars, the posterior ones in contact with the median head scales. However, the species most like the Texan lizard in the United States is the southern fence lizard. Although males of these two are very different in coloration, and females of the first get much larger than those of the other, young specimens and females of the southern fence lizard are difficult to identify. The dark markings, including a longitudinal black streak on the posterior surface of the thigh, will usually distinguish the southern fence lizard from the Texan spiny lizard in doubtful cases.

Habitat. These are typically tree lizards and can be found on any tree or building furnishing protection in the way of holes or cavities of any sort. They are abundant on mesquite trees, and occur on many others, such as hackberry, live oak, pecan, elm, cedar, and cottonwood (in order of preference).

Habits. Newman and Patterson have written an excellent account of the habits, habitat, and life history of the Texan spiny lizards. Their color blends well with that of the bark of trees, and they are frequently overlooked because of this protective coloration. One's attention is often attracted to them only by their noisy movements. They are as a rule rather wary and climb high in trees to escape danger. When closely pressed they frequently descend into holes in the trees.

Food consists primarily of insects (cf. Pritchett). Small vertebrates (lizards) are occasionally eaten. Specimens have been observed to drink by sucking water into the mouth; many other lizards lap water.

Mites (*Geckobiella texana*) frequently infest these lizards, concentrating in folds of skin, especially on the sides at the neck.

Problems. A most interesting problem concerning *olivaceus* is the exact name for the species. The name *olivaceus* was first applied to a specimen thought to be different from the ordinary Texas species. It was later concluded, however, that it would be wiser to call them the same. Formerly the common Texas species had been called either *spinosus floridanus* or just *spinosus;* without question the first name applies to another species, *u. undulatus,* and Texas specimens certainly are not the same as the Mexican *spinosus.* Thus it becomes necessary either to apply to the Texan spiny lizard a name not meant for it originally or to give it a new name. Only further exploration in the region of the type locality of *olivaceus* will satisfactorily solve this problem.

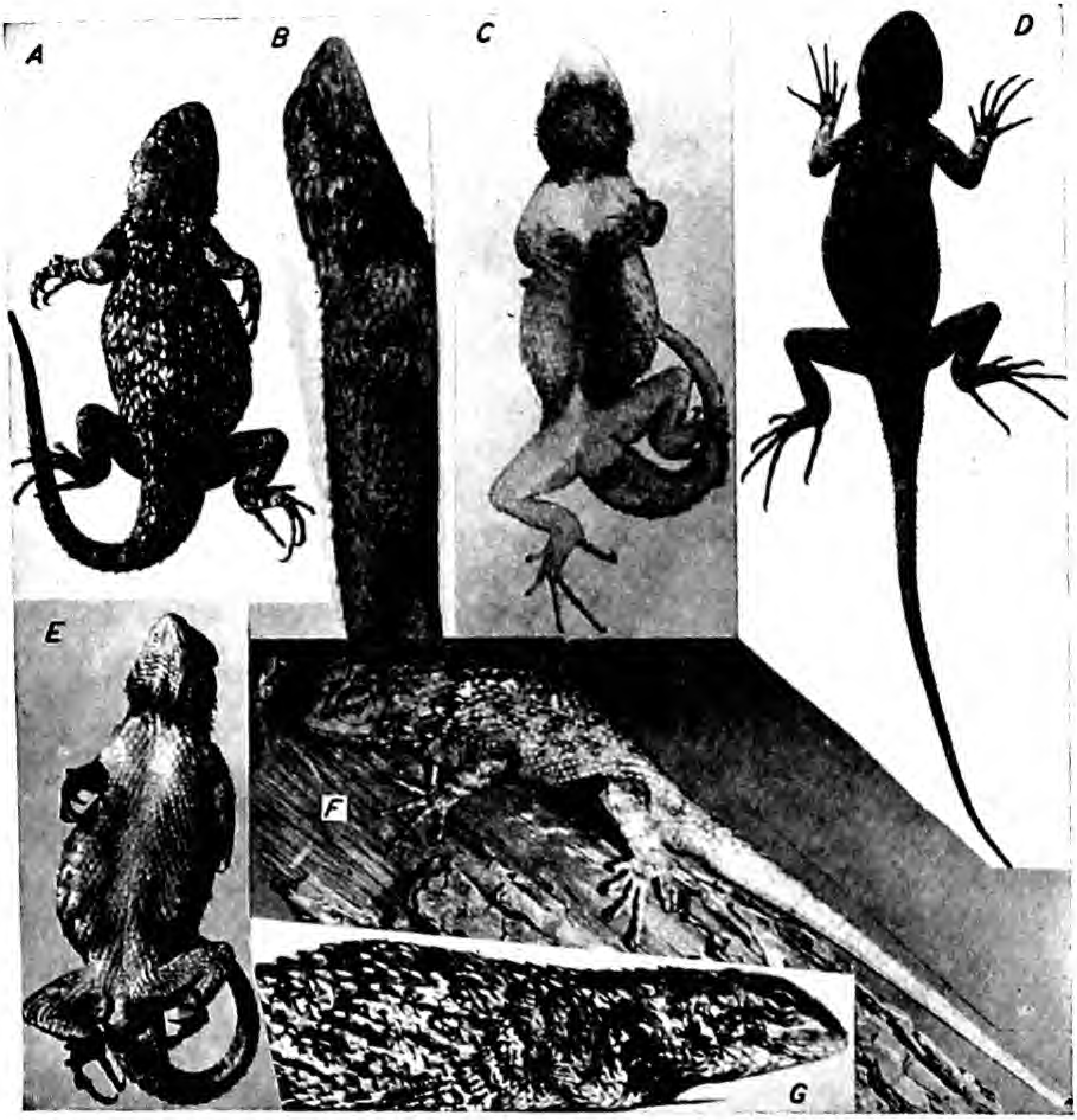
References. Newman and Patterson, 1909, pp. 1–24 (*lit. cit.*); Pritchett, 1903, pp. 271–287 (*lit. cit.*); Smith, 1935, pp. 277–279 (*Tex.*); *idem,* 1939, pp. 110–118, pls. 13, 14 (*gen. lit.*).

Clark's Spiny Lizard *Sceloporus clarkii clarkii* Baird and Girard (Pl. 45)

Range. Southeastern part of Arizona, extreme southwestern New Mexico, southward in Mexico through central Sonora. Type locality—"Province of Sonora" (actually the very northern part, now in southern Arizona). (Map 13, p. 493.)

Size. The largest specimen recorded was a male measuring 130 mm. (5⅛ in.) snout to vent. A large female measures 107 mm. (4¼ in.) from snout to vent. The tail is about 1⅓ to 1½ times as long as the body.

Color. Young specimens are gray, with 6 or 7 narrow, undulating, dark brown or black lines extending from the dorsolateral region to near the vertebral line. The band crossing the shoulders is frequently darker than the others. The sides of the body are darker and irregularly marked with dark brown; there the extensions of dorsal crossbands may be evident, but generally they are not. Narrow dark crossbands are also present on the limbs and tail, and are particularly evident on the forelegs. In adult males little trace of this pattern remains; they are gray above, with bluish flecks here and there, sometimes with irregular, narrow, dark lines on the edges of the lateral scale rows, and generally with some evidence of the shoulder crossband. Females also lose much of the juvenile pattern but retain it longer than males; the shoulder crossband is less evident. Both sexes, however, retain the crossbands



Pl. 45. *Sceloporus clarkii clarkii.* A, Montezuma Canyon, Huachuca Mountains, Arizona; female. B, C, Peña Blanca Springs, Arizona; male. D, Dos Cabezas Mountains, Arizona; half-grown female. U.S. Fish and Wildlife Service Photograph. E, Montezuma Canyon, Huachuca Mountains, Arizona; female. F, Grant Country, New Mexico; male. Gloyd photograph. G, Montezuma Canyon, Arizona; female.

on the lower foreleg; these are of considerable importance as an aid in identifying this species.

Females are marked below with rather broad, slightly convergent, dark lines on the throat; the sides of the belly may be mottled. In males the throat is pale blue, purplish, or greenish posteriorly; in larger specimens it is dark blue centrally surrounded by a black zone. The sides of the belly are marked with blue, light purple, or green from near the axilla to the groin; generally the patches are dark blue, separated medially by a narrow zone that becomes black in larger specimens.

Scalation. Supraoculars 4 to 6, the last two or three not separated from the median head scales, although the others are separated from them by a row of small scales; sublabials rarely in contact with mental; usually 3 auricular lobules, the upper ones (not the median ones) largest. Dorsal scales large, keeled, pointed, 28 to 36 from occiput to base of tail, average 32; femoral pores 10 to 16, average 12.3.

Recognition Characters. The large dorsal scales, the contact of the enlarged posterior supraoculars with the median head scales, the separation of the sublabials from the mental, the few auricular lobules with the upper largest, and the banded forelegs distinguish this species from others in the United States. The species most frequently confused with it, *m. magister*, lacks the bands of the forelegs, has more numerous (5 to 7) auricular lobules (the median ones largest), and generally has the sublabials in contact with the mental.

Habitat. There appears to be some disagreement in published notes on the habitat preferred by the species. According to some authors, trees are preferred; according to others, boulders. In certain localities where trees are rare, the species would find it necessary to live elsewhere, and boulders or rocky areas seem to be preferred to open desert. According to Dr. Edward H. Taylor's observations, as recounted to me, in areas in which *m. magister* and *c. clarkii* occur together the habitats are different, the former occupying the desert floor and boulders and *c. clarkii* the trees. In areas where *m. magister* does not occur *c. clarkii* extends its habitat to include boulders. It apparently finds the desert floor unsuitable.

Habits. Very little has been recorded. The species is not as wary as *m. magister*, typically a ground dweller. This agrees with observations in other groups: arboreal species tend to be less wary than terrestrial species of related groups.

The food apparently consists largely of insects. Kauffeld records a specimen collected during July that contained 24 eggs, each with a fairly well-developed embryo 4.5 to 5 mm. long.

Problems. The chief problem concerning this species is its natural history, of which surprisingly little is known in spite of the considerable size and commonness of the species.

References. Kauffeld, 1943, p. 345 (*Ariz.*); Smith, 1939, pp. 118–128, description, range, habits (*gen. lit.*); Van Denburgh, 1922, pp. 359–364, pl. 29, description, range, habits (*gen. lit.*).

Granite Spiny Lizard *Sceloporus orcutti* Stejneger

(Fig. 75, p. 182; Pl. 46)

Range. Southern California and most of Baja California, from southern San Bernardino County to the Sierra de la Gigante, and on some adjacent

Pl. 46. *Sceloporus orcutti*. A, B, Fallbrook, California; female. U.S. Fish and Wildlife Service photographs. C, Jacumba, California; male. D, Andreas Canyon, California; male

islands in the Gulf of California. Type locality—Milquatay Valley (near Campo), San Diego County, California. (Map 13, p. 493.)

Size. A species of moderate size, maximum snout-vent measurement about 109 mm. ($4\frac{1}{4}$ in.); tail about $1\frac{1}{4}$ to $1\frac{2}{3}$ times as long as head and body.

Color. General ground color in males coppery; a blue spot in the center of each scale on back, neck, limbs, sides of body and head; scales on sides of body with an additional small blue spot on each side of the larger median spot; a light yellowish spot on most dorsal head scales; a black shoulder patch, with some small, bluish spots scattered through it; entire ventral surface of head, body, and limbs cyanine blue; most of the scales of the throat and abdomen edged with black or rusty brown; the dark edges of the gular scales extensive, reducing the central blue area to small size; ventral surface of tail bluish.

Females variable in dorsal color pattern; usually more or less of a banded pattern evident; some with very distinct, alternating, light and dark bands, the lighter bands somewhat narrower; limbs and tail frequently distinctly banded, the light bands with a bluish tinge. Ventral surfaces immaculate, sometimes with faint bands across the abdomen and tail, the bands confluent with the dorsal bands; ventral surfaces sometimes tinged with blue.

Young with numerous alternating light and dark brown bands, much as in females.

Scalation. Dorsal scales 29 to 36, average 32.3; ventral scales 36 to 44, average 41; scales around body 29 to 37, average 34; femoral pores 10 to 15, average 13; supraoculars large, usually 5, the last 2 in contact with median head scales (Fig. 75); first infralabial at least partially in contact with first postmental.

Recognition Characters. Only one other lizard, occurring in much the same region as this, has large dorsal scales, no gular fold, and large supraoculars, the last 2 of which are in contact with the median head scales. This other lizard is the desert scaly lizard (*m. magister*). Live or well-preserved adults, especially males, are not at all similar in pattern and are easily distinguished; the granite lizard is speckled above, and the desert lizard is not; the entire ventral surfaces are dark blue in adult males of the former, not in the latter. But young specimens, females, and poorly preserved, faded specimens will undoubtedly cause trouble unless one is quite familiar with the pattern variation in the two species. The most reliable scale characters are the deep notches on either side of the median spine on the dorsal scales, and the at least partial contact of the first infralabial and first postmental in the granite lizard; these are not duplicated in the desert lizard except rarely.

Habitat. Rock cliffs and boulders are the haunts of these lizards. Areas with only scattered or small rocks are not inhabited; the boulders must be large and abundant. Klauber once observed one in a tree.

Klauber says that it

> is very common in rocky areas on both sides of the mountains, from San Gorgonio Pass south; a few specimens have been reported north of the San Bernardino plain. . . . One habitat where this lizard exceeds all others in numbers is in the mounds of granite which dot the valleys of Riverside County, between the Santa Ana and Elsinore Mountains, on the west, and the San Jacintos, on the east. Here they are very plentiful, especially in spring.

Habits. Almost all authors have remarked upon the wariness of these lizards, which take refuge in cracks in and between rocks before one can approach even close enough to shoot them by the usual means. However, it is said that in late afternoon they became so intent with their sun-bathing that one could approach within a few feet of them.

They are active mostly during morning and late afternoon when they can be seen perched on top of boulders. Klauber has observed them out as early as 7:15 A.M. During the hottest part of the day they are not so frequently seen.

Problems. The breeding habits and food are not recorded.

References. Klauber, 1939, p. 91, habits, habitat (*Ariz.*); Smith, 1939, pp. 133–140, description, range, localities, habits (*gen. lit.*); Van Denburgh, 1922, pp. 352–356, pl. 28, description, range, localities, habits (*gen. lit.*).

Desert Spiny Lizard *Sceloporus magister magister* Hallowell (Pl. 47)

Range. Southern California, excluding the western slopes, northeastern Baja California, Arizona, New Mexico, southern Nevada and Utah, southwestern Colorado, extreme western Texas, and southward to northern Durango and southern Sonora. Type locality—Fort Yuma, California. (Map 14, p. 493.)

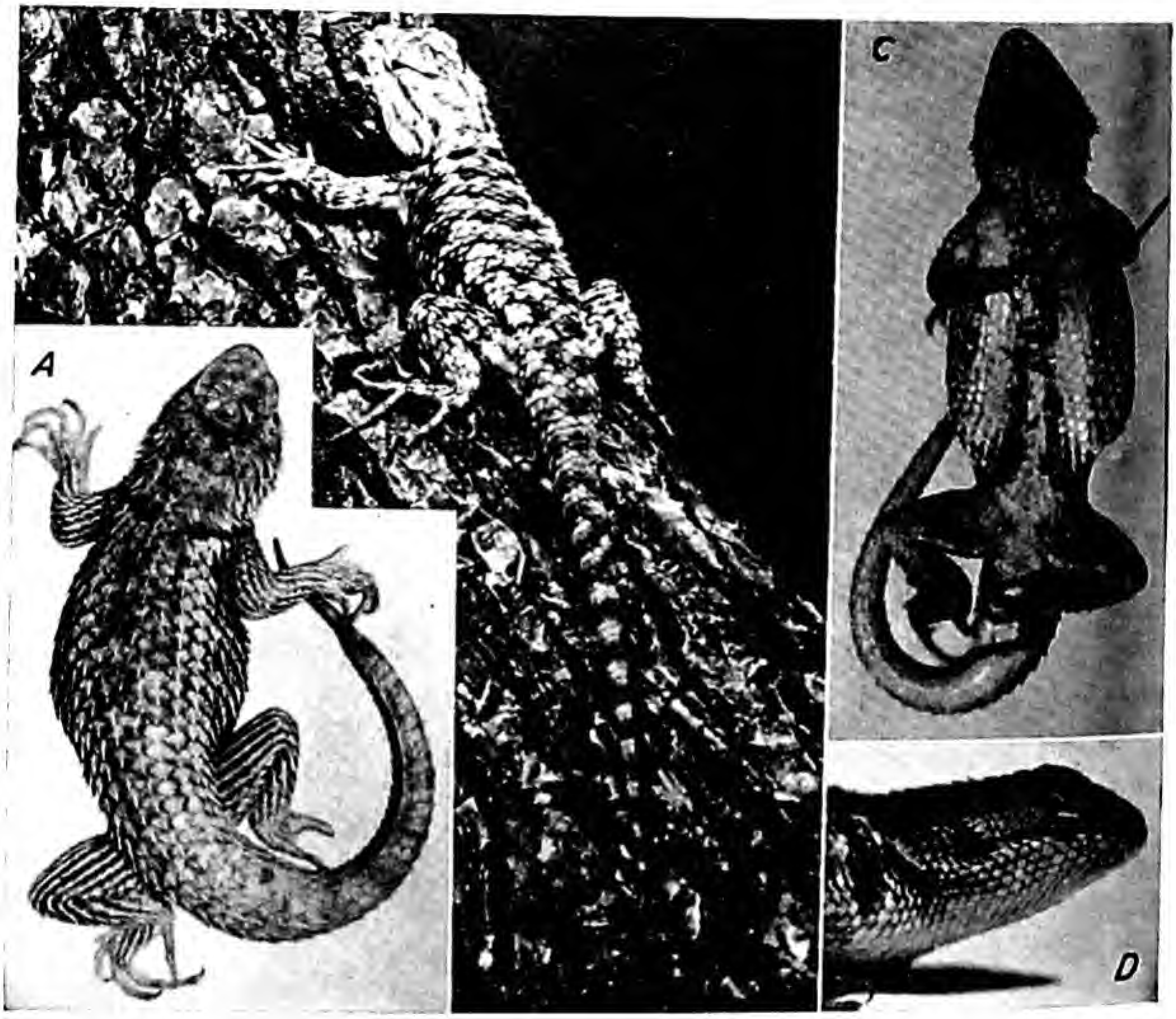
Size. A rather large species, with a maximum snout-vent measurement of about 140 mm. (5½ in.); tail about 1¼ to 1½ times as long as head and body.

Color. In males the dorsal surface is brown, sometimes with dim, transverse, dark bands across the middle of the back. The sides are rather abruptly darker than the back and tend to have dim, diagonal, light lines crossing them. There are dark streaks along the edges of the scale row on the legs but no transverse bands. The tail may be dimly banded. A dark streak extends posteriorly from the eye and joins the upper edge of the dark sides, which may be darker than the remainder of the sides; a triangular black patch in front of each foreleg with a dorsal continuation of dark brown that meets or nearly meets its mate. Sides of belly dark blue, with light blue spots frequently placed in diagonal series; posteriorly the blue expands and covers the entire groin, while anteriorly the blue becomes mixed with brown; the blue patches may meet medially and may extend forward somewhat upon the chest. Otherwise the chest, middle of belly, and ventral surfaces of limbs and tail white. The central gular region is light blue, and posteriorly it merges with a narrow black area confluent with the black nuchal collar.

In females and young the dorsal crossbands are more evident, and the nuchal collar is not black. The ventral surfaces are white, unmarked.

Scalation. Dorsal scales large, 26 to 37, average 32, from occiput to base of tail; ventral scales from gular region to anus 40 to 51, average 44; scales around middle of body 32 to 39, average 36; femoral pores 10 to 16, average 13; 2

parietals on each side of interparietal; 5 large supraoculars, the 2 posterior usually in contact with median head scales; first canthal usually in contact with lorilabials; outer row of sublabials in contact with mental, completely separating first infralabial from postmental scales; auricular lobules elongate, pointed (not rounded at tip), the largest about in the middle of the series.



Pl. 47. *Sceloporus magister magister*. A, Santa Rita Mountains, Arizona; male. B, Mesa, Arizona; female. Gloyd photograph. C, San Vicente, Texas; male. D, Santa Rita Mountains, Arizona; female.

Recognition Characters. The large dorsal scales, the absence of a gular fold, the large size of the supraoculars, and the contact of the posterior two with the median head scales distinguish this species from any other of similar appearance except Clark's spiny lizard. These two species have long been confused by herpetologists, even though the main differences between them were pointed out long ago by Stejneger, in 1893. They differ in many features of the pattern as well as in scalation; the belly patterns of males are particularly distinctive.

Habitat. The species is a ground dweller in many parts of its range, par-

ticularly in the southern part; there it is most frequently found about pack-rat nests or piles of debris among bushes; in these they seek refuge when disturbed. They also climb to some extent; various authors have recorded them in tree yuccas, *Opuntia* cactus plants, on telephone poles, pine trees, cottonwoods, willows, mesquite, and so on. They also have been taken in catclaw thickets, piles of rocks, undercut wash banks, railroad culverts, ruins of stone or adobe buildings, along cliffs, etc. Altogether the types of habitat are numerous, yet in the part of the range occupied with Clark's spiny lizard they keep well apart. Where there is no cover suitable for such a large lizard, they do not exist; thus they are absent on the open desert or on plains with low vegetation.

Habits. This is a very wary lizard, and a very noisy one as it rushes into its hiding quarters from open ground where it forages for its insect prey. It is never far from "home."

If the bushes are approached at a good pace the chances are that no lizard will be seen, for when frightened they scramble swiftly down the stems and into a hole, if there is time, or if not flatten themselves out against the trunk of the shrub or among the dead branches on the ground. In such cases they do not give themselves away by the teetering movement so characteristic of many lizards, and their extraordinary resemblance to the trunk or a lobe of an *Opuntia* makes them very difficult to discern. Many times I have seen an individual scuttle down the trunk of one of these cacti but on carefully approaching the bush would be unable to distinguish it, although it would be in full view. (Ruthven).

It is reported that when the specimens are running from bush to bush, the tail is lifted above the level of the body in much the same manner as in *Callisaurus*. A collector once found one asleep in early morning on the main limb of a small mesquite tree.

The food consists of insects and some vegetation. Various authors record plant remains in their stomachs, and one has observed them feeding upon cactus flowers. Of the insect food, ants predominate, with Coleoptera second in abundance. Stinging insects such as velvet ants and bees are not avoided. The food varies, of course, with the habitat and time of year. Sometimes other lizards may be eaten, but this is not so frequent an occurrence as with the leopard lizards.

Hibernation was noted by Rüthling in captive specimens, which hid under pieces of bark that lay under a thick covering of dead leaves when cold weather arrived. They refused to eat but would occasionally emerge on warm days. In midwinter Cowles found a hibernating specimen 18 inches below the surface of the ground, at the base of a mesquite tree.

Rüthling observed that the colors and markings were more distinct in captive specimens when they were eating or were excited on a hot day. Atsatt's experiments indicate that color change is directly correlated with tempera-

ture change, and at extremes is independent of other factors; at moderate temperatures illumination changes or psychological factors produce an intensification or weakening of the color.

Ruthven records specimens of this species in the stomachs of the leopard lizard, and suggests the road runner as a possible enemy. One specimen in the collection at Brigham Young University was taken from the stomach of a whip snake, *Masticophis flagellum piceus*. Nematodes have been reported frequently in the stomachs or intestines, and I have observed a tapeworm in one lizard. Wood reports on the intestinal protozoa.

Problems. The breeding habits remain surprisingly unknown. The apparently omnivorous habit needs further investigation. It is not improbable that two or more races actually occur in this widespread form, for the variation is considerable and part of it is correlated geographically.

References. Atsatt, 1939, pp. 157–158, color changes (*lit. cit.*); Cowles, 1941, pp. 130, 132 (*lit. cit.*); Knowlton, 1938, p. 238 (*Utah*); Ruthling, 1917, pp. 9–11 (*lit. cit.*); Ruthven, 1907, pp. 532–536 (*Ariz.*); Smith, 1939, pp. 145–161, pl. 15, description, habits, habitat, range, records (*gen. lit.*); Van Denburgh, 1922, pp. 329–338, pl. 27, description, range, habits (*gen. lit.*); Wood, 1935, pp. 166, 167, 168, 173 (*Calif.*).

The Undulatus Group

Although there are larger groups in the genus, this is the largest within the United States. It extends southward about to the middle of Mexico, and as far north as southern New York and British Columbia. Thirteen forms are recognized in the group, and only one does not occur in the United States. The group is not easily characterized.

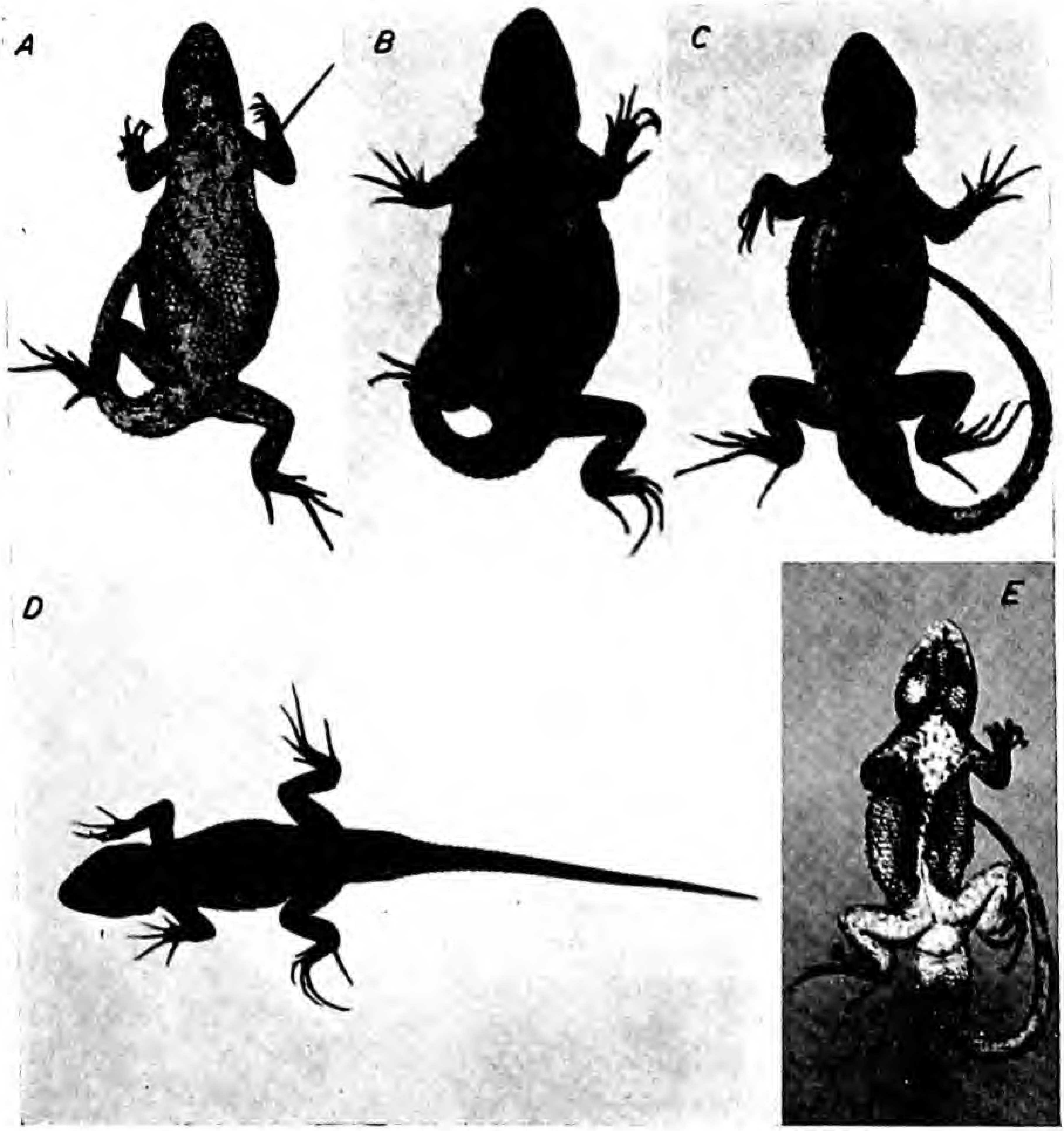
Southern Fence Lizard *Sceloporus undulatus undulatus* (Latreille)

(Fig. 73, p. 180; Pl. 48)

Range. Largely restricted to the southern coastal plain, from central South Carolina to central Florida and westward through central Georgia and Alabama, southern Mississippi, and southeastern Louisiana. Type locality—Charleston, South Carolina. (Map 15, p. 494.)

Size. The largest adult male of several hundred measured was 77 mm. in snout-vent length (about 3 in.), the largest female 72 mm. Generally females are somewhat larger than males, however, and it is to be expected that females larger than the one measured occur. Specimens are, on the whole, a little larger than *u. hyacinthinus*. Wright and Funkhouser give 155 mm. (6⅛ in.) as the maximum total length of a series from Okefenokee Swamp. The smallest young observed is 22 mm. (⅞ in.) in snout-vent length.

Color. The markings are like those of *u. hyacinthinus* except that they tend to be more brilliant. The black, especially, is more intense. In males the ven-



Pl. 48. *Sceloporus undulatus undulatus.* A, St. Petersburg, Florida; female. B, Mobile, Alabama; female. C, same locality; male. D, E, St. Petersburg, Florida; male.

tral surfaces frequently are almost entirely black, except for paired blue gular spots and the blue patches on the sides of the belly. A more or less well defined light spot may border each dark dorsal crossband posteriorly, in a dorsolateral position; these are more evident in live than in preserved specimens.

In females the small black flecks usually are more numerous and a little larger than in the northern race, and frequently they may form a broken, midventral, longitudinal line. They have a pair of blue areas in the posterior gular region, like the males, but the surrounding area is whitish, not black. The sides of the abdomen also may have a dim, gray-blue suffusion, simulating the lateral, blue, belly patches of the males.

The very young lack the blue ventral markings and are whitish with black

flecks below; dorsally they are marked with about 8 or 9 undulate, black or dark brown crossbars.

Wright and Funkhouser, describing Okefenokee Swamp specimens, state:

> The dorsal surface is usually grayish-black, sometimes a brilliant black. The undulating crossbands are often very faint or obsolete; when distinct they are generally 10 or 11 in number with the white markings prominent. The ventral surface of the body is yellowish-white with numerous dark spots in more or less regular rows. Down the median ventral line these spots run together to form a longitudinal stripe, which in all of the specimens from the swamp is quite prominent.

Scalation. See Fig. 73. Dorsal scales 31 to 40, average 34; scales around middle of body 35 to 46, average 40; femoral pores 11 to 18, average 14.6; scales between pore series 4 to 11, average 7.5.

Recognition Characters. Any lizard, within the range given above, with relatively large, spiny scales, is certain to be of this species. The only lizard that can be confused with it is the scrub pine lizard, which has somewhat smaller but overlapping and spiny scales; in the latter the dorsal scales usually number over 40, the maximum in the southern fence lizard. On the edge of its range the latter merges with the northern fence lizard; in such areas of contact it is necessary to secure a series and find the average number of dorsal scales; if it is 37 or less, the specimens can be referred to the southern race. There are some differences in color between the two races: adult females of the southern race have blue gular splots, whereas females of the northern race do not; and males of the southern race are more highly colored and the belly more nearly completely pigmented than in the northern race.

Habitat. Wright and Funkhouser state that the lizards are "abundant throughout the higher and drier portion of the Okefinokee and called by the natives 'scaly lizard.' Most common on the sandy pine lands, where they seem to prefer the fallen timber, logs, and stumps, and always to be found around fences and piles of cut wood." Carr gives the habitat in Florida as "high pine and upland hammock; on fallen tree trunks, especially those of pine."

Habits. As in *u. hyacinthinus.* Carr states that in Florida "the nine to thirteen eggs are laid in April and May under old logs and in beetle grass; they are 11.2–11.7 mm. by 6.5–7.1 mm."

Problems. A detailed comparison of the southern and northern races in habits as well as structure is much to be desired, especially in some area where one occurs within a short distance of the other, as in central or northern South Carolina. The exact northern and western limits of the range of *u. undulatus* are not yet well defined, although in the north the Fall Line presumably marks the boundary between the two races.

References. Carr, 1940, pp. 72–73 (*Fla.*); Smith, 1938, pp. 7–8 (*gen. lit.*); Wright and Funkhouser, 1915, pp. 124–127 (*Ga.*).

Southern Prairie Lizard *Sceloporus undulatus consobrinus* Baird and Girard

(Pl. 49)

Range. Southern central and southwestern Oklahoma southward through central Texas east to about Long. 97° 31′ W.; westward through most of the Texas Panhandle; extreme eastern and southern New Mexico; and southeastern Arizona at low elevations. Type locality—Beckham County, Oklahoma, near confluence of North Fork of the Red River and Suydam Creek. (Map 15, p. 494.)

Size. The largest male measured, from the United States, had a snout-vent measurement of 61 mm. (2⅜ in.); the largest female was, as in most *Sceloporus* species, a little larger, measuring 64 mm. Mexican specimens seem to reach a somewhat greater size, one male measuring 67 mm. snout to vent, a female 69.5 mm. (2¾ in.). The tail is about 1½ times as long as the body. The youngest specimen examined measured 26 mm. snout to vent.

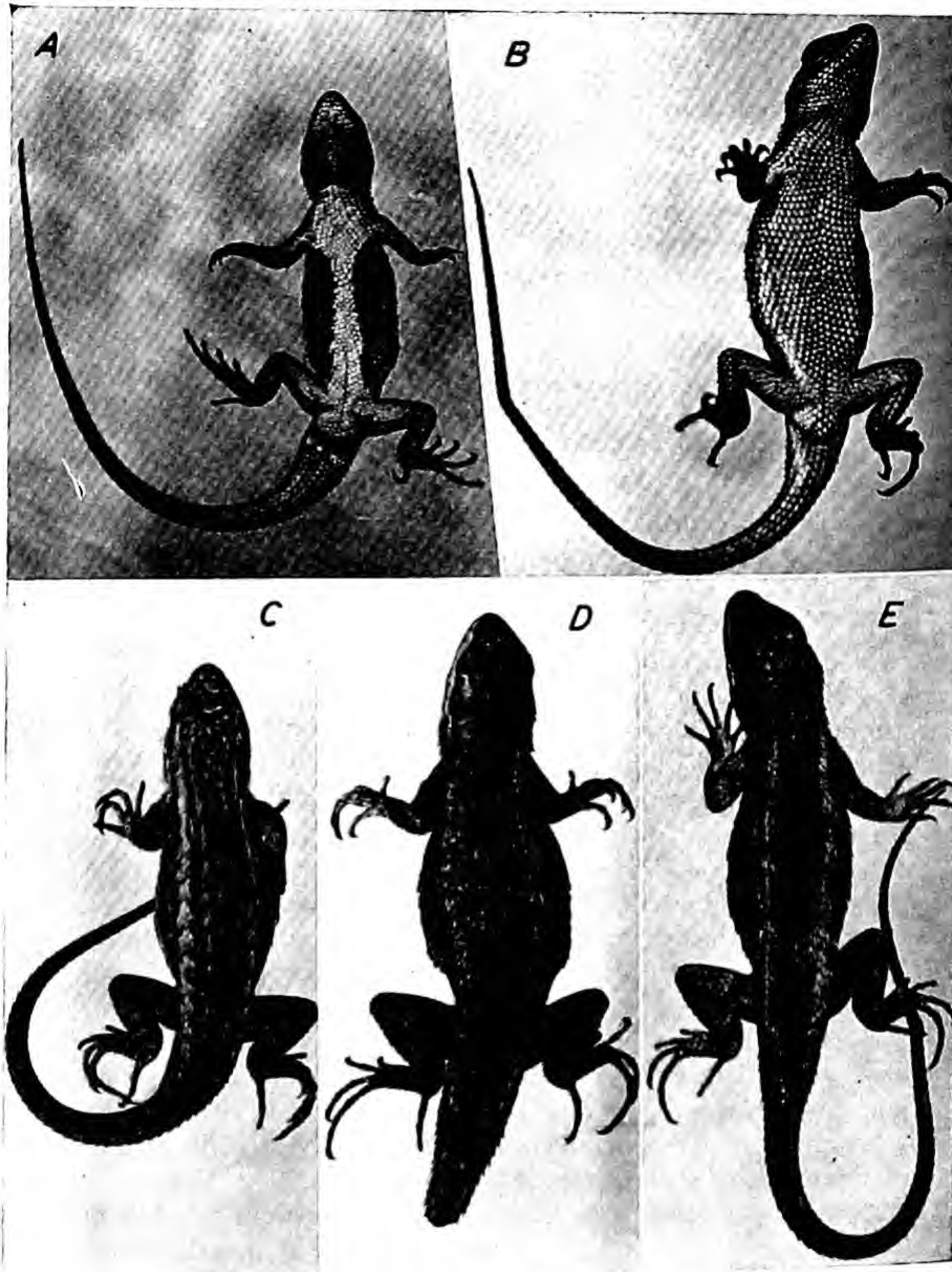
Color. Head brown or light clay-colored above; a well-defined, greenish, white, or light yellow stripe extends from the side of head along either side of the back and onto the base of the tail. Above this light stripe is a light yellowish-brown to dark or reddish-brown band about 2 to 3 scale rows wide, which is usually marked with a series of dark spots about 9 in number; a median dorsal band is light grayish slate to olive brown, unspotted. Limbs brown above, spotted irregularly with black. About 3 rows of scales below dorsolateral light stripes is another light stripe, usually poorly defined and with a very indistinct lower border; area between lateral and dorsolateral light stripes light to dark brown, with indistinct, small, dark spots more or less corresponding in position with those on dorsal surface.

On each side of the belly in males is a long blue area extending nearly from axilla to groin, somewhat darker or even narrowly bordered with black on its medial edge; blue belly patches widely separated from each other medially. On each side of the posterior part of the gular region is a blue area, sometimes bordered with a darker color; sometimes the two gular patches are confluent.

Some rare specimens show no dorsal pattern whatever, and are a uniform light brown above. These represent a color variant within the race and are not to be considered a different race or species.

Scalation. Dorsal scales 35 to 47, average 40; scales around middle of body 35 to 47, average 41; femoral pores 11 to 21, average 16; scales between pore series 2 to 8, average 7.

Recognition Characters. Toward the east the southern prairie lizard blends with the northern fence lizard, in a narrow belt through central Texas and eastern Oklahoma, more or less at Long. 97° 30′ W. It is impossible to know with certainty which name should be applied to specimens from this area, for naturally they are intermediate. As usual in this group, a series is necessary



Pl. 49. *Sceloporus undulatus consobrinus.* A, Hebbronville, Texas; male. B, same locality; female. C, Green Gulch, Chisos Mountains, Texas; female. D, same locality; male. E, Hebbronville, Texas; female.

to determine what name should be used. In the southern prairie lizard the dorsolateral light stripes are distinct in males; the dorsal dark crossbars are reduced in males and confined to areas between the dorsolateral light stripes; the gular region has 2 dark patches posteriorly, not extending over the entire throat, in males; the auricular scales are larger than the preceding scales and some extend across the ear; and the femoral pores are generally 16 or more (69.7 per cent). In the northern fence lizard the dorsolateral light stripes are very indistinct in males; the dorsal crossbars extend almost completely across back when visible; the gular region is almost entirely black in adult males; the auricular lobules are no larger than the preceding scales and none extend across the ear; and the femoral pores are generally 15 or less (80.7 per cent). It is well to remember that the southern prairie lizard is largely terrestrial, and the northern fence lizard is largely arboreal or at least is seldom found on the ground.

Within the area occupied by *u. consobrinus,* the only other lizards with relatively large, spiny scales have a black collar about the neck or have the dorsals much larger, 33 or less from occiput to base of tail.

Habitat. These are terrestrial lizards, reaching perhaps their greatest abundance in rocky terrains where small rocks or boulders give them places to hide and perches on which to sun themselves. On plains they occur near bushes, seeking refuge in the small mammal holes that are usually to be found near the bases of the plants. They occur either in mountains or on plains but are typically plains lizards. In mountains they may occur at elevations as great as 7000 feet.

Habits. Very little has been recorded of the habits of this race. Ruthven comments that "the stomach of the only White Sands [New Mexico, near Alamogordo] specimen examined contains a robber fly, the remains of a small beetle and a few ants. A specimen taken on the plains had eaten a grasshopper, a few small beetles, ants and one or two fragments of vegetable matter." Two females have been recorded from northwestern Texas, one with 6 and the other with 8 eggs, that had not been laid as late as June 2.

Problems. One of the most conspicuous and important problems relating to this race is the exact nature of the intergradation in central Texas and southeastern Oklahoma between this and the northern fence lizard. It is a study urgently needed, yet one which cannot be pursued satisfactorily in the laboratory alone. A careful attempt should be made in the field to recognize the fence and the prairie lizards in their typical forms. Then a careful survey should be made, crisscrossing the area of overlap or intergradation of these two forms, from as far north as possible in Oklahoma to as far south in Texas as feasible. In central Oklahoma the situation is complicated by the replacement of the southern by the northern prairie lizard.

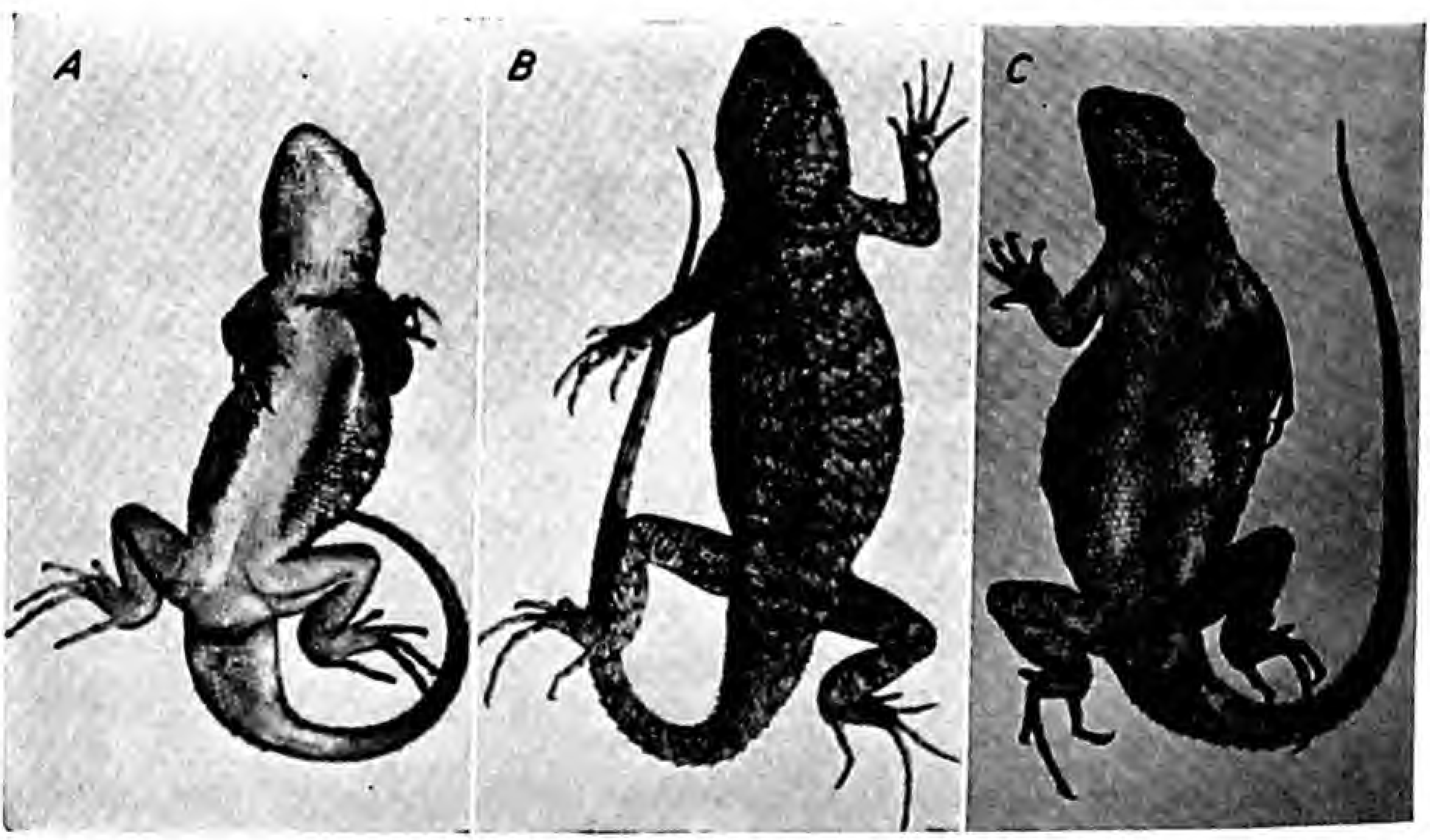
In addition, as with nearly all other lizards, very little is known of the life history and habits of this race. These are important to know in much detail,

for when such data are available for all species, there will no doubt be evident some very interesting generalizations not now even indicated.

References. There are no good, detailed descriptions of the southern prairie lizard. The best is in Ruthven, 1907, pp. 539–541 (*Ariz.*). His specimens from the Piñon-Cedar association, however, belong to a different race, the southern plateau lizard.

Northern Plateau Lizard *Sceloporus undulatus elongatus* Stejneger (Pl. 50)

Range. Colorado, except northeastern corner, and extreme south-central Wyoming; extreme western Oklahoma Panhandle; eastern half of Utah; northeastern corner of Arizona and northwestern corner of New Mexico. Type locality—Moa Ave, Painted Desert, Arizona. (Map 15, p. 494.)



Pl. 50. *Sceloporus undulatus elongatus.* A, Moab, Utah; male. B, C, Salina, Utah; female.

Size. This is the largest of the several races of plateau, prairie, and eastern fence lizards. The largest male measures 74.3 mm. (2⅞ in.) snout to vent, the largest female 81.5 mm. (3¼ in.). Females are frequently found that measure 70 mm. or more, and males measuring 50 mm. or more are common. The tail, as in others, is about 1½ times as long as the body.

Color. Van Denburgh describes the color of fresh specimens as follows:

The color above is yellowish, brownish, grayish, or greenish olive, usually with rather indistinct and very narrow undulate dark brown cross-bands. These dark markings are distinct and continuous, but usually are more or less broken up or obsolete. The sides in many specimens are colored like the back. Others have a

more or less definite dark brown longitudinal band running from the shoulder to the hind leg. The head, above, is yellowish brown or olive, unicolor with dark brown lines and dots. Narrow dark brown lines often run from the nostril to the eye, from the eye to the upper end of the ear-opening, and from the latter point to the shoulder. The upper surfaces of the limbs and tail are yellowish brown or olive, unicolor or more or less definitely dotted or cross-barred with dark brown. The lower surfaces are yellowish white with a bright blue spot on each side of the throat and an elongated patch on each side of the belly in both sexes.

Scalation. Dorsal scales 41 to 55, average 48; scales around middle of body 43 to 59, average 49; femoral pores 12 to 23, average 18; scales between pore series 3 to 10, average 6.7.

Recognition Characters. Within its range there are no other lizards with a similar dorsal scale count save the common sagebrush lizard. The latter has very small, almost granular scales on the posterior surface of the thigh, is much smaller, lacks transverse bands and the dark color, etc. In fact, the very high dorsal scale count separates the northern plateau lizard from all others of its complex, including the prairie lizards, the fence lizards, the southern and the striped plateau lizards. Of course, in areas of contact of the range with those of other races, a series must be available to determine what name is correct for that area.

Habitat. The northern plateau lizard is typically an inhabitant of canyon walls and boulder-strewn hillsides. Burt says:

> Adults were nearly always found on or very near to outcroppings of rock. Such was the case in Montrose County, Colorado, where rock cliffs and ledges lined the canyon of Roubideau Creek. The young, however, were found in sandy areas in the valley and several made their home near a cabin there. These particular young had a body length of from 26 to 29 millimeters and a tail length of from 38 to 44. They were found on August 10.

Regarding food Woodbury states:

> This lizard appears to feed principally upon terrestrial arthropods. In a few stomachs very small particles of plant tissue and small quantities of sand were present, probably accidentally ingested. It obtains food principally by stalking its prey but the presence in some of the stomachs of subterrestrial larvae indicate that it does some digging for its food.
>
> This species is primarily insectivorous, taking practically any insect available not too large to be handled. It appears to be fond of ants as it devoured more of these insects than of any other group. The examination of the stomachs showed more adults than larvae both in numbers and volume indicating, perhaps, a preference for the more rapidly moving type of insects.

A case is on record of a garter snake (*Thamnophis o. vagrans*) which ate one of these lizards.

Problems. One of the most interesting problems in western lizard taxonomy

is the identity of the southwestern Utah population here referred to the southern plateau lizard. Various authors have treated it in three different ways: as the western fence lizard, as the northern plateau lizard, and as the southern plateau lizard. Part of the confusion is due to lack of realization that the two characters—color and small scales—that define the northern plateau lizard do not change at the same point into the color and scale characters that define the adjacent race. Either character taken alone requires a different disposition of the intermediate populations. In the present discussion the scale count is emphasized, since interpretation of this cannot vary as can interpretation of color. There is much to be done in the field, however, to demonstrate the true nature of these intermediate specimens.

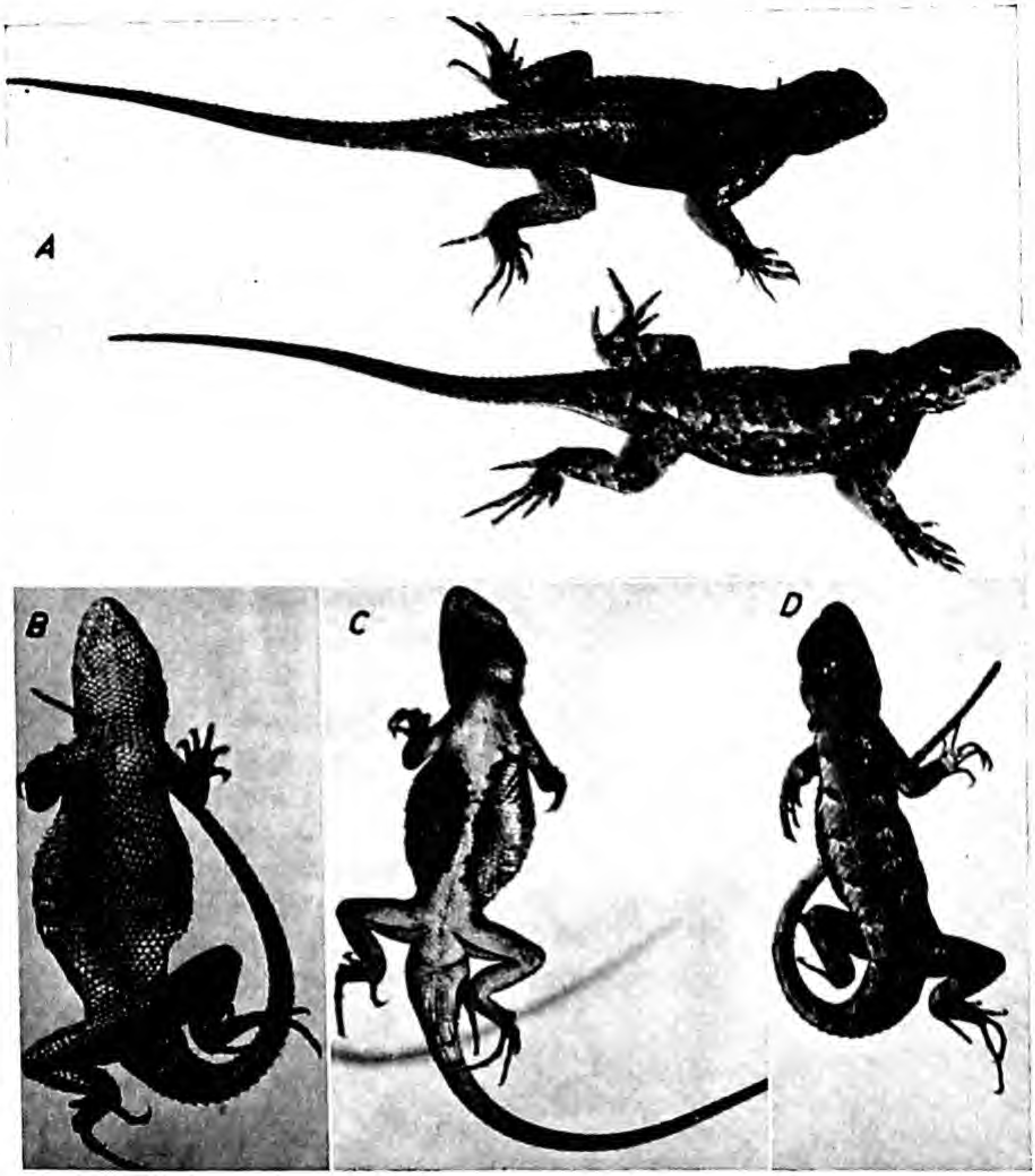
References. Burt, 1933, p. 243, taxonomy (*Ariz.*); Knowlton and Janes, 1933, pp. 1011, 1015, food (*lit. cit.*); Knowlton and Thomas, 1934, p. 258, food (*lit. cit.*); Smith, 1938, pp. 15–16, taxonomy (*gen. lit.*); Van Denburgh, 1922, pp. 295–297, pl. 22 (*gen. lit.*); Woodbury, 1932, pp. 14–15, food (*Utah*).

Northern Fence Lizard *Sceloporus undulatus hyacinthinus* (Green) (Pl. 51)

Range. Extreme southeastern New York westward through northern Pennsylvania, central Ohio, and perhaps Iowa probably to extreme southeastern Nebraska; southward in the West through extreme eastern Kansas, the eastern fourth of Oklahoma, and the eastern half of Texas; southward in the East to northern South Carolina and throughout the mountains and foothills from South Carolina west to Louisiana, reaching the southern lowlands and coast only in western Louisiana and eastern Texas. Type locality—Princeton, New Jersey. (Map 15, p. 494.)

Size. Specimens of the two sexes are of nearly equal size; the largest female of several hundred measured had a snout-vent measurement of 79 mm. (3⅛ in.), and the largest male measured 72 mm. The tail is about 1⅙ to 1½ times as long as the body. McClellan *et al.* state that in males the tail comprises an average of about 58 per cent to 60 per cent of the total length, whereas in females it is relatively short, averaging 55 per cent to 56 per cent of the total length. Newly hatched young measure from 20.6 mm. to 25 mm. (13/16 to 1 in.).

Color. Adult males with a dorsal ground color of varying shades of grayish brown, sometimes bronze; sides of body, from a line above insertion of the limbs to the belly, at least a little darker than back, sometimes much darker; on back a series of poorly defined, narrow, undulate, slightly darker brown, transverse bars about 6 to 10 in number, usually 7 to 9, these bars sometimes dimly evident on sides of body; on tail a series of dim, alternating, light and dark rings, the dark ones about twice as broad as the light ones; fairly distinct, narrow, dark crossbands present on forelegs, but seldom evident on



Pl. 51. *Sceloporus undulatus hyacinthus*. A, Patuxent Research Refuge, Bowie, Maryland; female and male. U.S. Fish and Wildlife Service photograph. B, Weymouth, New Jersey; female. C, same locality; male. D, San Antonio, Texas; male.

hind legs; head brownish, with scattered dark markings, the most regular of which is a very narrow transverse band across the middle of the supraocular region. Ventral surface of head black, except for light areas about lips; a broad, bright, dark blue or green area, sometimes separated into 2 lateral areas on posterior part of throat, entirely surrounded by black; shoulders black; middle of chest white; bright blue areas on sides of belly bordered medially by a black edge; generally a light stripe down middle of belly, but

sometimes the black on the belly completely obliterating it; the pore region on the hind legs is sometimes rather bright yellowish.

Adult females colored like the males except for the following differences; sides of body less dark, frequently no darker than middle of back; undulate cross bands on back and sides more distinct; ventral surface of head and belly whitish, with scattered, small, black flecks.

The young females are colored like the adults of that sex, and the very young males cannot be distinguished from them in color; as the males become a little larger (body about 1½ in.), however, the black flecks become increasingly numerous and light blue patches appear on the throat and sides of belly.

Scalation. Dorsal scales 35 to 49, average 42; scales around middle of body 38 to 51, average 44; femoral pores 11 to 19 on each side, average 14.5; scales between pore series 4 to 11, average 7.4; supraoculars generally in 2 rows, the scales in the outer row much smaller than others, and usually 5 or 6 scales in the inner row.

Recognition Characters. Within the range outlined for the northern fence lizard, any rough, spiny-scaled lizard, with scales large enough to be seen plainly, is certainly of this species. Near the southern and western limits of its range, however, some difficulty may be encountered in determining whether this or some other race is involved. The southern fence lizard may easily be distinguished, if a series is available, by usually having 37 or fewer dorsal scales (92 per cent); the northern race usually has 38 or more (95 per cent). Comparisons with the two prairie lizards are given in the treatment of each.

Habitat. Over much of the territory where the species occurs, the northern fence lizards are fairly common. They prefer relatively dry, open, sunny woods, usually on hillsides, but may be found in open areas on houses, in piles of logs, fences (whence the name), or in brush heaps. They are usually found near some sort of protective cover in which they take refuge when alarmed. Judging by abundance of specimens, the eastern pine forests are their optimum habitat. Although frequently found on the ground, elevated objects on which they can climb are an essential component of their habitat.

Habits. A great deal has been written in a casual way about the life history and habits of this lizard, but no comprehensive study of them has yet been made. The best and most complete local study is that of McClellan *et al.*

Emergence from hibernation occurs as early as February 10 in Missouri, and in New Jersey they are seen in early March; they begin hibernation as late as November 15 in Missouri, and probably earlier in more northern localities (November 5 is the latest date of observation recorded for Maryland). The time of emergence and disappearance in any locality in any particular year depends not only upon the latitude but also upon local variations in weather. Adults are said to spend a longer time in hibernation in both fall and spring than young specimens. Hibernating quarters are burrows in the ground, spaces under or between rocks, or within rotten logs or stumps.

Upon emergence from hibernation the lizards enter the breeding season, which lasts several weeks. During this time they are very active and react quickly to the presence of others of their species. They choose a more or less restricted area in which to live, and a male will guard his domain from others of his sex. Fights occur frequently between males crowded in small areas or wandering from their usual domain. It is said that the anal region rather than the head is the focus of attack (McClellan *et al.*). One or two females are usually to be found in the territory of any male, but they do not defend their territories nor do the males prevent them from wandering. Copulation occurs at intervals in April and early May. According to Noble no definite family ties are formed, but McClellan believes there may be some constancy of relationship between a male and a female.

The constancy of mates is interrupted by captivity, where the lizard begins life again in altered circumstances. A male thus thrown into the society of a strange female at any fairly early date will usually breed with her, though meeting with no encouragement. In several cases of captive breeding the mates have come from places a mile or more apart. . . . In captive breeding the female is never compliant at first, and may succeed in quite repelling the male's advances. As a typical case among several, a male taken on April 3rd received a mate from another locality on April 7th, and tried to breed at sight, but was repulsed at first. The female avoided his advances by moving about in short, jerky hops, with her back arched, but never tried to bite the male. The next day, April 8th, several more attempts were unsuccessful. Similar efforts on April 16th and 17th were equally futile. The male at last accomplished his purpose on April 18th, at 9 A.M. and 2 P.M. The process was repeated on April 22d at 9.45 A.M. and 2.30 P.M., and finally on April 23d at 8.45 A.M. and 3 P.M. The first of these six occasions, on April 18th, could have been as much as two weeks later than a natural breeding in the female's state of freedom, before her capture on the 7th. . . . The attitude of both lizards towards this second union, if such it was, proved interesting. On April 19th two strange males were introduced into the cage. One of them was instantly engaged in combat by the male already in possession. The female took no notice of either, until the unoccupied stranger approached her directly, when she drove him away with a vigorous bite, a measure she had never adopted towards her captive mate. The two intruders were then removed. On the other hand, the male of this captive pair completely ignored a second female introduced on April 25th. The captive union, once established, was kept inviolate by both parties (McClellan *et al.*).

Very incomplete records suggest that in Maryland some 8 weeks are required for the gestation period. Then the eggs, 4 to 17 in number, are laid ½ to 4 inches below the surface of the ground, "just deep enough to unite the constant moisture of the subsoil with indirect warmth conducted from a sunlit surface." Sandy soil may be preferred. Oviposition may be delayed several days until a spot is found where the proper conditions are met. On one occasion there was some indication that the female, when given the means of moistening the soil as much as necessary, by tipping a water-filled

pan, was capable of judging how much water had to be added to bring the sand to the proper state for egg deposition. The lizard makes its own burrow and, after an hour or so occupied in actual oviposition, covers the eggs and fills the burrow by drawing the excavated materials "toward her body with her forefeet and passing it to the rear with her hind legs."

Egg laying has been recorded for May through early August in various parts of the range, but probably in any one area the season normally includes only about a 6-week period; in Maryland the dates recorded are between the extremes of May 27 and July 1, and commonly fall in early June and late May. When laid the eggs are white, but later become dingy. They vary from 12 to 18 mm. in length and 7 to 13 mm. in width at deposition; by hatching time the length increases by about ⅓ over the original dimension, the width by about ⅝.

The period of postdepositional development in Maryland is estimated at about 10 weeks under normal conditions, 12 in captivity; in North Carolina a developmental period of 67 days is recorded in one case. Thus the young appear at any time from late July to mid-September in Maryland. The embryos develop features of the pattern when only about half grown (much later in *Cnemidophorus*). The hatchlings increase markedly in size before hibernation for their first winter and the following year grow enormously, so that by the second spring they are fully adult and ready to mate. The duration of life is unknown, but records assure us that it exceeds 4 years normally.

The food consists mostly of many kinds of insects, but also includes spiders, snails, millipedes, pseudoscorpions, and probably other kinds of invertebrates. McCauley studied the contents of the stomachs of forty specimens, and remarks:

> Generally speaking, it appears that *S. u. undulatus* [= *S. u. hyacinthinus*] will eat any insect or spider it can catch and master. Except for size no limitations are apparent. The examination of the alimentary tract itself indicates, as a list of data cannot, that medium-sized and small insects are preferred. Insects are seldom found large enough to have taxed the lizard's swallowing capacity. On the other hand, a stomach and intestine will frequently be stuffed with innumerable ants, small beetles, tiny spiders, and other diminutive forms and their remains. By actual examination rather than by a list of species found, one is convinced of the voracious appetite of this lizard. For sheer numbers of insects that frequently appear in a single stomach at one time, it is unique among the five species here considered [including *Cnemidophorus sexlineatus, Leiolopisma laterale, Eumeces fasciatus, E. laticeps*].

Usually only moving prey is taken, for it is movement that attracts these lizards' attention normally.

The lizard sees small objects clearly at a distance of a few feet, and quickly notices anything in motion. At close quarters even the movement of an antenna

may attract its attention. It captures its prey by a sudden dash, seizing it between the jaws, where it is first crushed and then well chewed. The tongue seems to aid but little in mastering a large mouthful, which is tossed gradually farther to the rear while being chewed. If the morsel is both long and bulky, such as a larva just capable of being grasped by one end, it is often flung into pieces by violent shaking, and the separate fragments retrieved afterwards. In captivity, once a certain kind of food has become familiar, dead and motionless examples may be investigated and taken as well as moving ones (McClellan *et al.*).

Most of the food hunting is accomplished early in the morning, after a brief sun bath. Then during the hotter parts of the day they are more quiescent; toward evening they may forage again for food before retiring into shelter for the night. On cool and cloudy days they may not emerge at all, and on other days they may remain active from near dawn to late afternoon. "Digestion is active, though we cannot say just how rapid. However much or often a lizard might eat, I have never known refuse to be voided oftener than once a day, usually early in the morning" (McClellan *et al.*).

When pursued they seek concealment, rather than simple flight. They move quickly, in short runs. On a tree they keep to the side opposite the enemy, and if they climb high they soon return to lower levels. When captured they sometimes bite and struggle to escape, but after a short time they cease such antics and can be handled with ease. In a few months they may become completely tame, losing all sign of fear of human beings. Although they submit to captivity, they do not live well unless great care is taken to provide them with nearly natural conditions.

Observation of many captive specimens makes it appear probable that in the wild state they spend the night at a slight distance above ground instead of under some terrestrial shelter. My own captives invariably sleep either on an inclined branch of wood or some inches up the wire screening. Here they may hang upright, horizontally, or head downwards for the whole of their night's rest, the position of the uppermost limbs always suggesting that most of the weight hangs from them, and that sleep tends to contract the muscles controlling the hooked claws and give them firmer hold. This habit of sleeping aloft is quite constant, even when bark or other acceptable shelter is provided on the flooring (McClellan *et al.*).

During the day about as much time is spent on the ground as on elevated objects.

Tiny red mites, *Geckobiella texana*, are found sometimes in the axillary region or in the pocket on the side of the neck.

The "skin" is shed in small sections or even scale by scale, not in large pieces. The number of times shedding occurs is not known.

There is some change in coloration according to temperature, the brightest hues being brought out in the sun at moderately warm temperatures. On cool days the dorsal pattern becomes much darker.

Problems. One of the most interesting problems concerning this race is

the identity of the specimens from the Ouachita Mountains area of Arkansas and central eastern Oklahoma. It has been suggested that these are in reality the southern plains lizard (see Dellinger and Black, pp. 8–10, *Ark.*). Good series from these areas are much to be desired.

References. Burt, 1928, pp. 19–27 (*Kans.*); Conant, 1938, pp. 22–26 (*Ohio*); Ditmars, 1936, pp. 55–57 (*gen. lit.*); Fowler, 1907, pp. 198–201, description (*N.J.*); McCauley, 1939, pp. 150–151, food (*Md.*); McClellan, Mansueti, and Groves, 1943, pp. 6–17, pls. 1–3 (*Md.*); Noble, 1934, pp. 1–15 (*lit. cit.*); Noble and Bradley, 1933, pp. 64–71, 92, 93 (*lit. cit.*); Smith, 1938, pp. 8–10, map (*gen. lit.*); Surface, 1908, pp. 254–258, habits, etc. (*Pa.*).

Northern Prairie Lizard *Sceloporus undulatus garmani* Boulenger (Pl. 52)

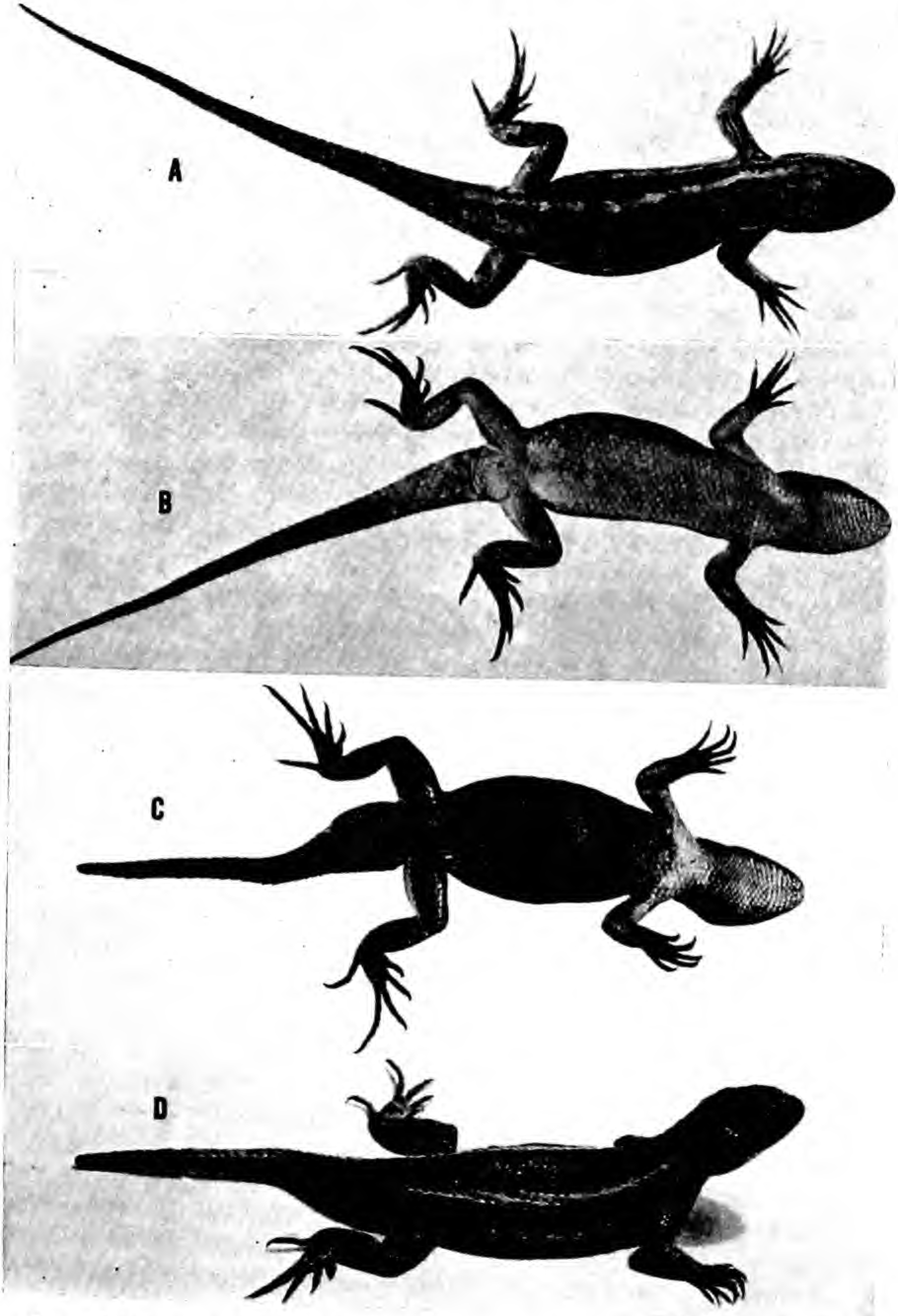
Range. Central and northwestern Oklahoma west of about the 95th meridian and north of the Washita River, all of Kansas west of about the 97th meridian, the western half of Nebraska, extreme southern central South Dakota, northeastern Colorado, and southeastern Wyoming. In Kansas and probably Oklahoma it rarely occurs on large rivers somewhat farther east than stated above, being carried downstream on floating logs, etc. It has been taken on the Kaw River as far east as Lawrence, Kansas. In Kansas it is separated from contact with the fence lizard, but in Oklahoma the ranges are in contact and intergradation between the two races occurs. In the extreme western part of the Oklahoma Panhandle the northern plateau lizard is found. Type locality—Pine Ridge, South Dakota. (Map 15, p. 494.)

Size. This prettily marked race is, on the average, a little smaller than any of the related eastern or southern races. The largest male measures 54 mm. snout to vent (2⅛ in.). The tail is, as in related races, about 1½ times as long as the body.

Color. Above light to reddish brown, head no darker; a very well-defined, dorsolateral, light line, extending from eye to base of tail, 1 to 2 scale rows wide; on the median side of these stripes, a series of about 9 small, irregularly shaped, dark brown spots, each about 1 or 2 scales wide; in the middle of back a light brown stripe, unmarked by darker colors. Sides of body uniformly brownish, sometimes with a poorly defined lateral light line extending from axilla to groin, and sometimes enclosing dark spots that correspond in position with the dorsal spots. Limbs with irregular dark marks above.

In males the sides of the belly are light blue, from the axilla to the groin; the two blue areas are widely separated from each other medially. Generally there are no throat markings in males. There is no spotting on the chest or middle of abdomen.

Females are a uniform white below, lacking the flecks of dark color characteristic of the fence lizards.



Pl. 52. *Sceloporus undulatus garmani.* A, B, 10 miles southwest of Winfield, Kansas; female. C, D, Hackberry Lake, Gordon County, Nebraska; male. U.S. Fish and Wildlife Service photographs.

Scalation. Dorsal scales 35 to 46, average 41; scales around middle of body, 35 to 47, average 43; femoral pores 10 to 16 on each side, average 13; scales between pore series 4 to 8, average 5. Median series of supraoculars relatively small, the outer series distinct.

Recognition Characters. Within the area occupied by the northern prairie lizard, there is no other species with large, spiny, dorsal scales, that can be confused with it. The only difficulties arise at the periphery of its range, where it may meet the southern prairie lizard, the northern fence lizard, and the northern plateau lizard. It can be distinguished from the first by the absence of gular marks in males and in having usually less than 15 femoral pores (93 per cent) on each side (the southern prairie lizard usually has 15 or more [89 per cent]). The northern fence lizard usually has complete undulating black marks on the back and poorly defined light stripes, the males have very prominent gular marks, reach a much larger size, etc. The northern plateau lizard has smaller, more numerous dorsal scales (usually about 48), more numerous femoral pores (usually about 18), lacks distinct light stripes, usually has complete, undulating crossbands on the back, and reaches a larger size.

Once these differences from adjacent races are known, no difficulty is encountered in distinguishing the northern prairie race. It is the smallest of all, has the fewest femoral pores, the best development of the light stripes, the greatest reduction of dorsal spots, and the fewest ventral markings. A good color plate of this is given in the original description (see below).

Habitat. The northern prairie lizard is found in a number of habitats. In sand dunes and in sandy areas it is almost as abundant as the earless lizard, which is more characteristic of such habitats. They are usually found in these dunes near bushes, into which they dash when disturbed. They also occur in hilly areas on sandstone cliffs, where they climb about on the rocks with agility. They are not typically rock lizards, however, but seem to use the rocks mainly as vantage or sunning spots and as places of refuge. They forage in the sparse grass on the ground at considerable distances from the rocks but scurry back to cover when alarmed. The white chalk cliffs of western Kansas also furnish them with a suitable habitat. On the open prairie they are abundant wherever they can find shelter, and are found commonly under shocks of wheat. Where there is no surface cover, they are less abundant and find shelter in holes in the ground.

Habits. Grasshoppers and beetles, of small size, form the bulk of the diet of this insectivorous lizard. Large insects may be killed but not eaten. Lady-bird beetles are usually rejected. Honeybees are not molested, and perhaps for good reason, as Burt cites a case in which a medium-sized male was stung by a honeybee and died a few minutes later.

Hartman says that "these lizards are often found climbing weeds or brush. One of this species was observed clinging to an old sunflower stalk three feet

from the ground. In color the lizard mimicked the weed so perfectly that it would escape ordinary notice."

Burt records seven Kansas females with 7 to 11 eggs in the uterus; they averaged about 8 eggs each. The egg size is about 10 mm. by 6 mm. Egg laying is recorded for the dates of June 8 and June 12.

An interesting case of polydactylism is recorded in a specimen from Kansas.

Problems. One of the most interesting problems in connection with the northern prairie lizard is its relation to the northern plateau lizard in northeastern Colorado. Typical specimens of both races have been examined from Milton Reservation, Weld County. It would be an interesting point if it were proved that both races lived in the same territory and yet remained perfectly distinct. This is not the usual situation in regard to subspecies; usually they occupy adjacent, but not overlapping, territories. Of course, the two races are linked with each other by intergradation with southern races, so in a roundabout manner it seems necessary to consider the two as subspecies, even though they may not intergrade directly.

The southern and western limits of the range of the northern prairie lizard are yet to be well fixed.

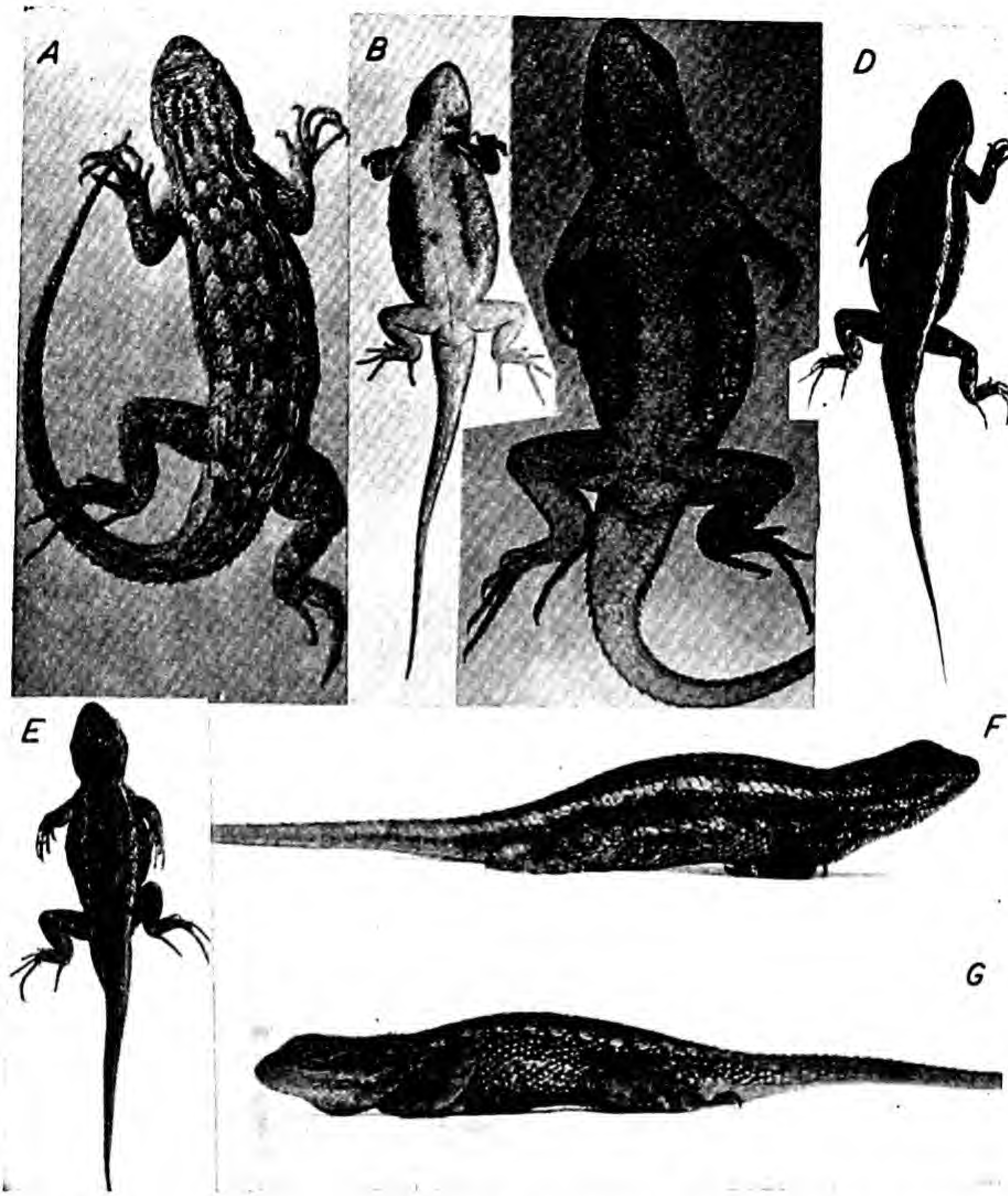
References. Boulenger, 1882, p. 761, pl. 56 (*S.D.*); Burt, 1928, pp. 16–19 (*Kans.*); Hartman, 1906, pp. 225–226 (*Kans.*); Smith, 1938, pp. 14–15 (*gen. lit.*).

Southern Plateau Lizard *Sceloporus undulatus tristichus* Cope (Pl. 53)

Range. Areas usually of higher elevation over all of New Mexico except the southern third and extreme northwest; central and northern Arizona, except northeastern corner; southwestern Utah. Type locality—Taos, New Mexico. (Map 15, p. 494.)

Size. The largest male measured was 76 mm. (3 in.) snout to vent; the largest female 72 mm. This probably is not a true picture, as females are usually larger than males. The male mentioned above is probably very near the maximum size of the race, for no other males measured approached its size; several females were seen measuring about 70 mm., however. The smallest specimen seen measured 27 mm. (1⅙ in.) snout to vent, but probably the hatching size is a little less.

Color. This race is rather variable in dorsal coloration. The dorsal color generally is olive, sometimes light brown to reddish brown. Darker colors are the rule in this race. Males may have fairly distinct dorsolateral light lines, dusky to dark greenish yellow; the lower edges of the stripes may be well defined, the inner edge grading off into the ground color; in such cases the area between the stripes is nearly uniform, with a series of about 9 or 10 poorly defined dark spots on either side; the sides are a nearly uniform light brown, sometimes with a narrow, poorly defined, light stripe extending from



Pl. 53. *Sceloporus undulatus tristichus.* A, Canyon Diablo, Arizona; male. B, D, F, Lakeside, Arizona; female. C, 22 miles west of Gallup, New Mexico; male. E, G, Lakeside, Arizona; male.

axilla to groin. Other males have very poorly defined dorsolateral light stripes; in these the dorsal dark spots are expanded laterally and extend as undulate dark bars from near the middle of the back to the sides of the body; the bars are separated from each other medially by a space occupying about 3 scale rows. There are poorly defined, broken, narrow crossbars on the

limbs. The sides of the belly are cobalt blue, from axilla to groin; the blue areas have a narrow, black, median border widely separated from each other; there is a blue area on either side of throat posteriorly, also black-edged; the rest of the ventral surfaces are white, frequently rather heavily suffused with black and with numerous small, scattered, black flecks; usually a broken, narrow, midventral, black line is evident at various points.

Females are colored like the dark males above, having a dark dorsal color, poorly defined light stripes, and rather well defined, transverse, undulate dark bars. In ventral coloration the females of this race are the most extraordinary of the whole genus in the United States, for they have almost exactly the same markings as the males. The blue, black-edged, gular patches are present, and the blue belly patches; the only difference between the sexes in ventral coloration is that the black borders of the belly patches are absent in the female, and the black suffusion and spotting of the throat and belly also are absent. Even so, until one becomes very familiar with these lizards, it is difficult to be sure whether one is a male or a female without looking at the enlarged postanal scales.

Scalation. Dorsal scales 35 to 46, average 42; scales around middle of body 36 to 53, average 45; femoral pores 13 to 22, average 16.7; scales between pore series 3 to 9, average 6.

Recognition Characters. A number of other, somewhat similar lizards occur in parts of the range of the southern plateau lizard. Perhaps most like it is the sagebrush lizard; but this has tiny scales on the posterior surface of the thighs, the lateral preanal folds extend anteriorly between the femoral pore series, the throat never has distinct blue spots posteriorly, etc. The size of the dorsal scales well separate it from any other species occurring in its range.

The closest relative of the southern plateau lizard is the southern plains lizard. The latter generally has more distinct stripes and less well defined transverse bars on the back, and the females, of course, lack the usually distinctive masculine marks on the sides of the abdomen and throat.

Habitat. In general this lizard is characteristic of the Piñon-Cedar association. It is a terrestrial race, frequenting rocky places. It may be in the mountains or on plains, but does not occur in strictly desert areas at low elevations.

Habits. Little has been recorded on the life history and habits of this race. In Zion National Park, Woodbury says:

> It is a rock- or tree-dwelling form and can climb with agility up the faces of rocks, buildings or trees. It seems not to be frightened of humans as it will live on the walls of cabins that are daily occupied. It is an insectivorous form. I have watched it catch grasshoppers, crickets, leaf hoppers, ants, moths, bugs and other forms of insects. A grasshopper alighted near one, and the lizard made such a lightning-like dash to the spot that it had the insect almost before its wings were folded. Sometimes they will run long distances over a wall and stop near an insect,

creep slowly until within range and then make a quick dive. They will often sit on the side of a rock or building and watch you curiously, and may be easily captured by the hand.

They form a portion of the food of at least certain snakes, including one of the whip snakes (*Masticophis t. taeniatus*).

Problems. A great deal of work needs to be done on this race to clarify its relationship to the southern prairie lizard and to the northern plateau lizard. This means not only counting scales and other characters in the laboratory but also making comparative observations in the field on its life history and habits.

References. Cope, 1900, pp. 376–377, description, (*gen. lit.*); Woodbury, 1928, p. 16 (*Utah*).

Striped Plateau Lizard *Sceloporus undulatus virgatus* Smith

(Pl. 54)

Range. Mountains of southeastern Arizona, eastern Sonora, and western Chihuahua, as far south as southwestern Chihuahua. Type locality—Santa María Mine, El Tigre Mountains, Sonora. (Map 15, p. 494.)

Size. This is one of the smallest of the whole group of plateau, fence, and prairie lizards. The largest male measured 59 mm. (2⅜ in.) snout to vent, the largest female 62 mm. It is notable that the largest are northern specimens, from areas near the range of the larger race, the southern prairie lizard. Sonora specimens do not exceed 58 mm. in the female, 51 mm. in the male.

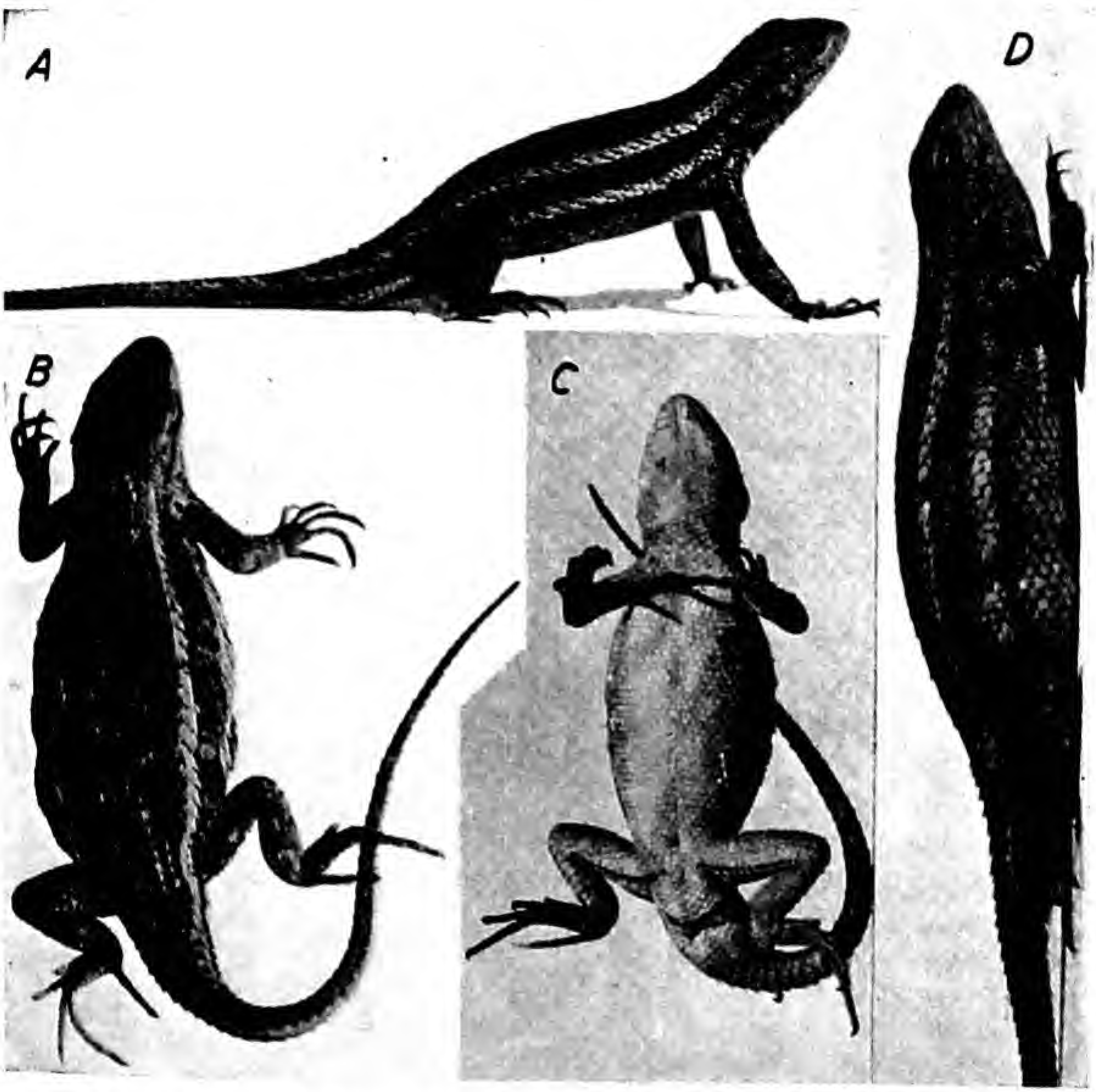
Color. Dorsal ground color russet brown; a distinct, uninterrupted, dorsolateral, light line extending from upper labial region through ear, above arm to groin and a short distance on anterior surface of thigh; a distinct, dark brown stripe below lateral light line, extending from lateral nuchal pocket to groin and on anterior surface of thigh; a distinct brown band on each side between the dorsolateral and lateral light lines, extending from posterior margin of eye to base of tail; a short dark band extending from anterior surface of upper foreleg to lower edge of lateral nuchal pocket.

In females, 9 or 10 crescent-shaped, dark marks in a series on each side of middorsal line; each dark spot in some specimens has a small light spot on its medial posterior edge. In males these dorsal dark spots are practically obsolete; the light spots, in turn, are enlarged and are bordered anteriorly by a narrow dark line.

The males do not differ from the females in ventral coloration, lacking all evidence of typical belly marks. In both sexes a small, pale blue spot is present on each side of the throat posteriorly; it is not dark-bordered. In some specimens a few dark flecks are present on the chest; the ventral surfaces are otherwise immaculate white.

Scalation. Dorsal scales 36 to 42, average 38.5; scales around middle of body 40 to 48, average 43.2; femoral pores 12 to 16, average 14; scales between pore series 4 to 7, average 4.8.

Recognition Characters. This race is peculiar in lacking a ventral pattern on



Pl. 54. *Sceloporus undulatus virgatus.* Cave Creek, Chiricahua Mountains, Arizona. A, C, male; B, D, female.

the belly in males as well as females—a condition not occurring in any other spiny lizard of the United States. Other recognition characters are the very distinct light stripes, 2 on each side; the presence of a narrow dark stripe below the lateral light stripe; the small size; and the reduction in dorsal spotting and femoral pore count. It has at times been confused with *S. scalaris slevini,* but the latter is easily distinguishable by the close approximation of the femoral pore series, the presence of only 2 postrostrals, lateral scale rows parallel, etc.

Habitat. The striped plateau lizard evidently occurs only at a considerable elevation. The race that inhabits the desert floor in southeastern Arizona is the southern prairie lizard, and the striped lizard occurs only higher in isolated mountain ranges. It is known in that area from the Chiricahua and Huachuca Mountains.

Habits. Not recorded.

Problems. The race seems rather well defined, but a detailed study of the vertical distribution of this and the southern prairie lizard in southeastern Arizona is much to be desired. The race may occur in southwestern New Mexico.

References. Smith, 1938, pp. 11–14 (*gen. lit.*); Van Denburgh, 1896, p. 341 (*Ariz.*).

Pacific Fence Lizard *Sceloporus occidentalis occidentalis* Baird and Girard

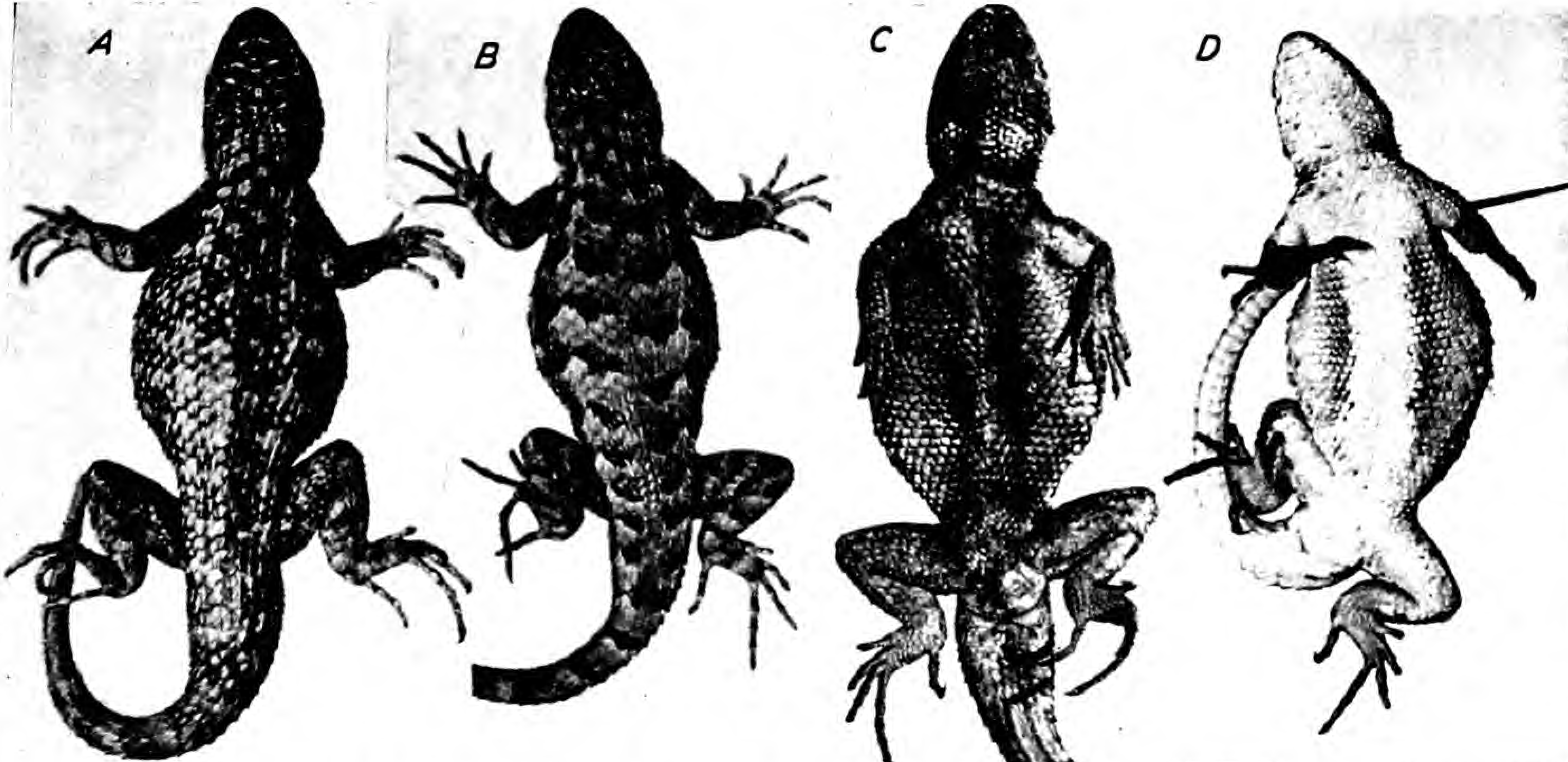
(Pl. 55)

Range. British Columbia southward through western Washington and Oregon, to southern California (Ventura County); in the south the range is confined to areas near the coast; in the north it extends as far east as Lake County, Oregon, and Modoc County, California. Type locality—Benicia, California. (Map 15, p. 494.)

Size. Males reach their maximum size at about 75 mm. (3 in.) snout to vent, while the females average around 70 mm. and reach a size somewhat greater than males.

Color. As described from fresh specimens by Van Denburgh,

> the color above is grayish, brownish, or olive, usually with one series of crescent-shaped or triangular brown spots, edged posteriorly with pale blue or green, on each side. A paler longitudinal band usually separates the dorsal and lateral regions. The sides are brownish or buffy, mottled with darker brown and dotted with green or pale blue. Narrow brown lines cross the head, but are more or less interrupted. A brown line connects the orbit and upper corner of the ear and is continued backward on the neck. A large blue patch on each side of the belly is usually bordered internally by a black band of varying width. The throat is white, more or less dotted or suffused with slate or black, and with or without a blue patch on each side. In highly colored males, the black bands of the belly meet medially, and the throat is intensely black with large round blue patches which sometimes merge on the median line. The preanal region and the lower surfaces of the limbs are white, sometimes dotted or tinged with slaty-black. The posterior surfaces of the limbs are yellowish, deepest on the thighs, along the back of which runs a dark line. In young, and some females, the green edging of the dorsal spots is replaced by gray or buff.



Pl. 55. *Sceloporus occidentalis occidentalis.* Portland, Oregon. A, C, male; B, D, female.

Scalation. Dorsal scales 35 to 46, average 42, not much larger than lateral or ventral scales; femoral pores 13 to 20.

Recognition Characters. In the area in which it occurs, there are no other lizards with large, spiny scales that can be confused with this. To the south and east the Pacific fence lizard intergrades with the western fence lizard. The latter has but a single, central, gular patch in males, while the Pacific has one on each side; and in the western fence lizard the ventral surfaces of chest, middle of belly, and thighs tend to be gray or black.

Habitat. Van Denburgh says:

It is usually to be found about fences, piles of wood or stone, the great brush-heap homes of the wood-rat (*Neotoma*) or roadside banks honeycombed with abandoned gopher (*Thomomys*) holes, which afford it ample opportunity to hide upon the approach of danger. In winter it sometimes is found in the interior of decaying logs, but I believe that it frequently hibernates under ground.

Habits. Fitch has studied the growth and behavior of this race in considerable detail. He summarizes his work as follows:

Growth in the fence lizard takes place during three periods. In the first period, between the time of hatching and the time of entering hibernation, growth is rapid but highly variable because of variations in the length of the growth period and in climate. Most of the eggs hatch in August, but some hatch as early as mid-July or as late as mid-September. Newly-hatched young are less than 30 mm. in head and body length and weigh less than 1 gm. They are more terrestrial than adults and more easily captured, and mortality is high among them. They remain active in the fall later than do adults. Most of the growth occurs between the first and second hibernations. When the lizards begin this period, they usually have a head and body length of from 35 to 45 mm. They grow so rapidly that in the fall they often cannot be distinguished from adults. The amount of growth, however, is erratic and unpredictable; individuals of the same age living in the same locality may differ greatly in their growth over a given period; some grow so slowly that they may be mistaken for members of the subsequent year's brood. Following their second hibernation, fence lizards are sexually mature, but their growth continues until fall, after which it ceases, or at least is greatly slowed down.

Adult fence lizards may molt but once a year, in August. In their first growing season the young probably molt several times. In the season following the first hibernation they may molt four or five times.

Extent and rapidity of tail regeneration varies greatly in different individuals; regeneration takes place mainly within a few weeks after the tail is broken.

Males and females pair off during the breeding season in early spring, but pairs are also frequently found in close association at other times of year. Males court females by making characteristic bowing movements, displaying the bright blue of the ventral surface. The same display is used to intimidate other males. Before mating, the female is shy and elusive. Gravid females are aggressive and will not tolerate courting by males. Eggs are deposited in May or June in burrows made by the females.

Adults are tolerant but not solicitous of young; the fighting instinct appears early in young males. Males are especially intolerant of each other in the breeding season. They tend to space themselves at intervals, and each selects as headquarters some favorable location which it defends against other males. But territorial boundaries are not sharply defined and are continually shifting. Where food and shelter are abundant, several males may live in close association; under such circumstances one is dominant. Territorial and mating behavior have much in common; in fights between males mating behavior sometimes appears.

Individuals are extremely localized in their movements and may live their entire life within a radius of a few hundred feet; when moved, they do not find their way back to their home territories. Spheres of activity are gradually shifted over periods of weeks or months in response to environmental changes; males move about more than females, probably because of the territorial pressure exerted upon them by other males.

The average life span is short; at Dark Hollow each year there was more than 80 per cent replacement of the population (but some of the replaced individuals were probably still alive, having moved elsewhere). The potential longevity is more than five years.

Fence lizards are preyed upon by many kinds of snakes, birds, and mammals; the yellow-bellied racer is perhaps one of the most effective natural enemies. Fence lizards usually escape their enemies by running and hiding, but may actually take the offensive in driving away small mammals.

Hibernation may occur as late as the last of November and terminate as early as the middle of February. Six to 13 eggs, average 9, are laid, sometimes over a period of as much as 8 days. They average 11.5 mm. by 7 mm. When laid they are creamy white and translucent, but soon after drying become opaque and chalky white.

Specimens have been found infested with ticks and mites.

References. Ditmars, 1936, pp. 53–54 (*gen. lit.*); Fitch, 1940, pp. 151–172 (*lit. cit.*); Grinnell and Linsdale, 1936, pp. 36–37 (*Calif.*); Grinnell and Storer, 1924, pp. 626–628 (*Calif.*); Van Denburgh, 1922, pp. 298–304, pl. 23 (*gen. lit.*); Wood, 1936, pp. 69–70, 177 (*lit. cit.*).

Channel Island Fence Lizard *Sceloporus occidentalis becki* Van Denburgh

(Pl. 56)

Range. The larger islands off the coast of Santa Barbara County, California: San Miguel, Santa Rosa, and Santa Cruz. Not on the Ana Capa Islands. Type locality—San Miguel Island. (Map 15, p. 494.)

Size. Maximum size somewhat more than 70 mm. (2¾ in.).

Color. Van Denburgh describes fresh specimens as follows:

The color above is grayish, brownish or greenish blue, with a series of dark brown blotches on each side of the back. A pale longitudinal band separates the

Pl. 56. *Sceloporus occidentalis becki.* Santa Cruz Island, California. Courtesy of J. R. Slevin. A, B, male; C, female.

dorsal from the lateral regions. The sides are brownish or grayish, mottled with darker brown and dotted or suffused with green or pale blue. The head is usually crossed by narrow brown lines, more or less irregular in distribution. A brown line connects the orbit and upper corner of the ear, and is continued backward on the neck. There is a large blue patch on each side of the belly, bordered internally with black in highly colored males. The chin and throat are blue, pale anteriorly and changing to black posteriorly, crossed by narrow, oblique black lines which converge posteriorly and blend with the black patches on the throat and in front of the shoulders in males. There is a white patch at each side of the anus, and a yellowish white band along the series of femoral pores.

Scalation. Dorsal scales 43 to 48; femoral pores 14 to 19, average 16.

Recognition Characters. The chief characteristic of this insular race is the arrangement of dark lines radiating from the posterior gular region. On one island, San Miguel, the supraoculars are invariably in contact with the frontoparietal, but this is not usually the case in specimens from the other islands.

Habitat. The channel island lizard "is common in parts of Santa Rosa and Santa Cruz islands, where its habits seem not to differ from those of *S. o. occidentalis*. We found it usually on the ground under bushes or clumps of cactus, on banks of earth, or on rocks; a few were seen on trees and stumps. We found it most abundant along the creek-bed on Santa Cruz Island" (Van Denburgh).

References. Van Denburgh, 1905, pp. 2, 3, 4, 9–10 (*Calif.*); *idem*, 1922, pp. 318–321, pl. 25 (*gen. lit.*).

Western Fence Lizard *Sceloporus occidentalis biseriatus* Hallowell (Pl. 57)

Range. Southern, central, and western California (west of a line through San Luis Obispo, western Merced, Coulterville in Mariposa County, to eastern Modoc County), southeastern Oregon, southwestern Idaho, all of Nevada, extreme western Utah, and western Baja California north of Lat. 30° N. Type locality—El Paso Creek, Tejon Valley, California. (Map 15, p. 494.)

Size. The western is a little larger than the Pacific fence lizard, adults measuring from 75 to 90 mm. (3 to 3½ in.) snout to vent. The tail is about 1½ times as long as the body.

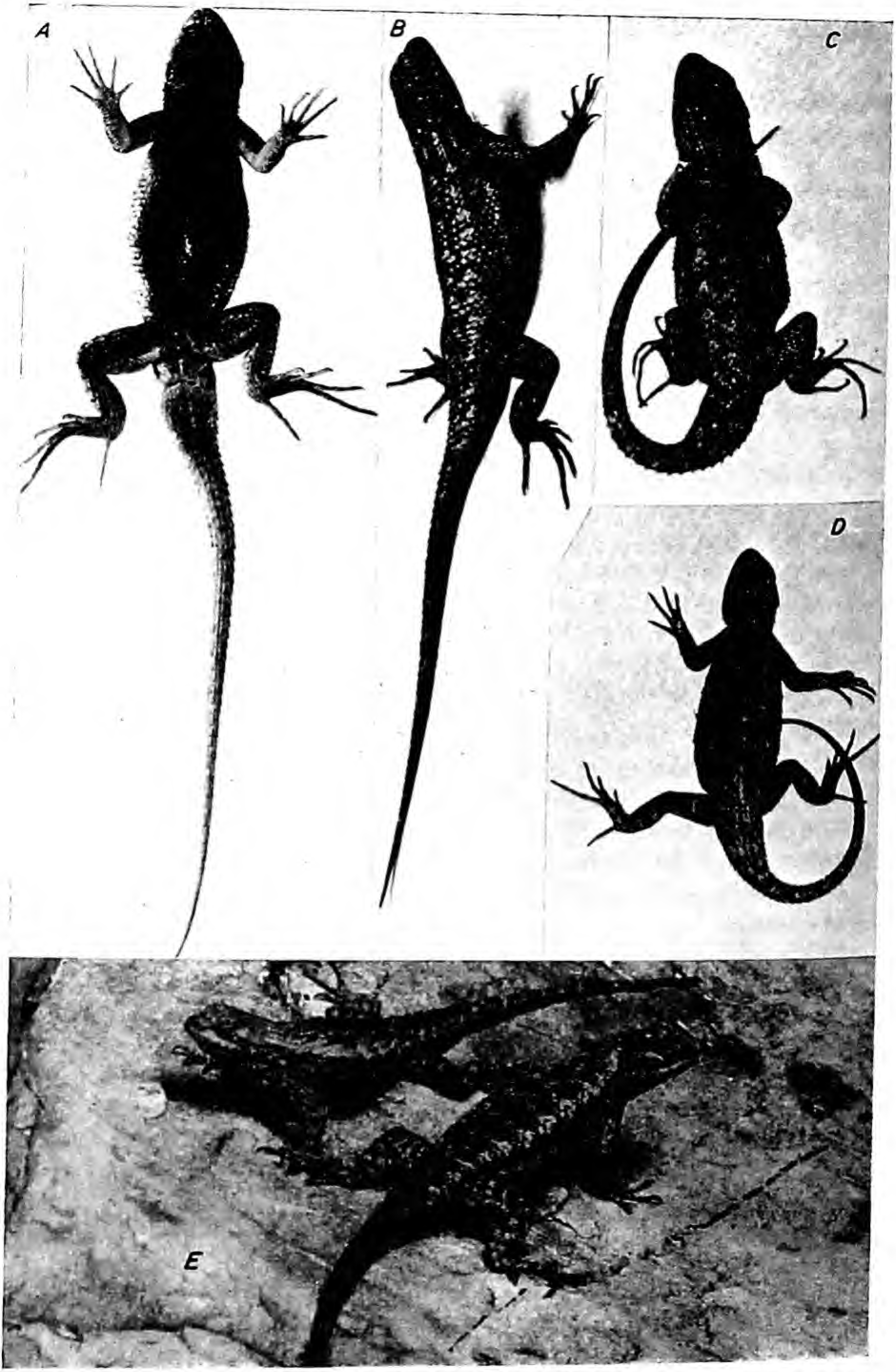
Color. In fresh material described by Van Denburgh,

> the back is brown, olive, or grayish buff, marked with large blotches or undulate cross-bands of dark brown, and more or less dotted, spotted or blotched with green or pale blue. The sides are similarly colored. Above, the head is brown or olive with narrow lines of dark brown, which are most distinct between the eyes and on the temples. The tail is olive or brown with irregular dark brown rings. All the lower surfaces are grayish or yellowish white, often suffused with slate or dull black. Along each side of the belly is a large patch of deep blue, but females may have two lateral patches. The posterior surfaces of the limbs are yellow.

Scalation. Dorsal scales 35 to 44, average 40; femoral pores 13 to 19, average 16.8; scales between pore series 8 to 12.

Recognition Characters. The undulate dark marks on the back, the dorsal scale count, and the presence of 2 series of supraocular scales (the scales in the outer series rather small) serve to distinguish this lizard from any other in the region.

The most frequently encountered difficulty in identifying *o. biseriatus* occurs in eastern Nevada and western Utah, where the ranges of the northern and southern plateau lizards overlap that of *o. biseriatus*, or are near it. *S. o. biseriatus* can be distinguished from these in pattern and in certain minor features of scutellation. In the plateau lizards the throat spots are widely separated and barely come in contact medially in large males; in *o. biseriatus* there is but 1 median, blue, gular patch except in the young, which may have the blue patch divided medially. Even in the young *biseriatus* the gular patches are not widely separated as in the plateau lizards. In dorsal pattern the plateau lizards frequently have faded markings; the crossbands number about 9 to 11 from shoulders to the base of tail. In *o. biseriatus* the markings are evident throughout life, and the bands number about 6 from shoulders to the base of tail. In details of scutellation *o. biseriatus* generally has 8 to 12 scales between the femoral pore series (smallest possible count), the scales posterior to the femoral pores are usually keeled (except sometimes in the



Pl. 57. *Sceloporus occidentalis biseriatus.* A, B, Cucamonga Canyon, Ontario, California; male. U.S. Fish and Wildlife Service photographs. C, Deerhorn Flat, San Diego County, California; male. D, same locality; female. E, Olive, California; male and female. Gloyd photograph.

first row), and the entire interior of the lateral nuchal pocket is covered with small granular scales; in the plateau lizards there are generally less than 8 scales between the pore series (or as few as 3), the scales in several rows posterior to the pore series are generally smooth, and the upper part of the interior of the lateral nuchal pocket is usually lined with bare, scaleless skin.

Habitat. The western fence lizard is perhaps the most conspicuous member of the rich and varied reptilian fauna of southern California, at least in its preferred habits. It is abundant almost everywhere it occurs. It is largely restricted to a rocky habitat and is particularly abundant in rocky canyons. Yet it is to be found also on trunks and limbs of trees, on fences, on old buildings in the country, and so on. In short, it is an almost ubiquitous lizard preferring a saxicolous habitat but spreading perhaps by sheer force of numbers into other habitats that furnish protection and allow use of its climbing powers. These lizards are not ground-loving, although they frequently forage on the ground for food; in common with many other animals their first instincts in seeking protection are to climb something and then to hide.

Habits. According to Ruthven and Gaige,

> as has often been noted, this *Sceloporus* is an excellent climber. It clings with ease to a vertical or even overhanging rock face and when alarmed rushes away with surprising swiftness. In this habitat it is quite inconspicuous, the pattern of light-colored individuals resembling the color of the rock, and the dark individuals appearing very like a crevice or angle in the rock face. When on the rocks, many of the old individuals are entirely black above to the obliteration of the pattern, but this color rapidly changes when they are removed. This black color is not only acquired when the lizard is upon black rocks but also when it is on red or brown rocks.
>
> On warm days the lizards, after they appear in the morning, are quite common everywhere over the rocks until the hottest part of the day, when they retire to the shady side. The food in the stomachs examined consists entirely of insects. Large females taken on and before July 12 contain large eggs apparently about ready to be laid, while those collected on July 22 had deposited their eggs. The first young were observed on August 14. On the latter date several young ones which could have been but a few days old were found among the rocks in Moleen Canyon. The one obtained measured 55 mm. in total length and 25.5 mm. exclusive of the tail. They ran about over the ground and small rocks at the base of the cliff and were very agile and shy, quickly seeking concealment under loose stones when alarmed.

In Oregon the young have been observed as early as July 25. In southern California specimens emerge during any part of the winter on warm days. Color-changing proclivities are relatively great. Richardson says, "This color vanishes so rapidly after death that dark-colored individuals will assume the normal gray-brown tint in less than three hours."

The known egg complement varies from 7 to 1.

It has been recorded that one specimen once squirted blood from its eyes, as do horned lizards, when the neck was slightly squeezed by a thread loop. Klauber records a prompt reoccupation of boulders in a fire-swept area a few weeks after the fire occurred. Among other enemies are recorded alligator lizards (*Gerrhonotus scincicauda webbii*), one of which ate two young fence lizards, and a whip snake, *Masticophis lateralis*.

Problems. No very complete studies have been made of the food of this race. There are numerous outstanding ecological problems. Taxonomically the most interesting problem is the relation of this race to the northern and southern plateau lizards.

References. Grinnell and Grinnell, 1907, pp. 22–25, figs. 3, 4 (*Calif.*); Klauber, 1939, p. 90 (*Ariz.*); Ruthven and Gaige, 1915, pp. 19–21, pl. 5, fig. 1 (*Nev.*); Van Denburgh, 1922, pp. 304–415, pl. 24 (*gen. lit.*).

For detailed notes on food, see Knowlton, 1934, p. 1002 (*lit. cit.*); *idem*, 1937, p. 110 (*lit. cit.*); Knowlton and Janes, 1933, p. 1015 (*lit. cit.*); *idem*, 1934, p. 12 (*lit. cit.*); Knowlton and Thomas, 1934, p. 258 (*lit. cit.*); *idem*, 1934, p. 264 (*lit. cit.*); Richardson, 1915, p. 412 (*Nev.*); Woodbury, 1931, pp. 38, 44–46 (*Utah*).

Yosemite Fence Lizard *Sceloporus occidentalis taylori* Camp
(Pl. 58)

Range. Upper basins of the Tuolumne and Merced rivers, between altitudes of 7300 feet and 8200 feet, in Yosemite National Park. Type locality—halfway between Merced Lake and Sunrise Trail (Echo Creek basin), altitude 7500 feet, Yosemite National Park, California. (Map 15, p. 494.)

Size. This is the largest of the western fence lizards, reaching a size of at least 94 mm. snout to vent (about 3¾ in.).

Color. According to Van Denburgh,

> the back is brown, olive, or greenish gray, marked with large blotches or undulate cross-bands of dark brown, and more or less dotted, spotted or blotched with green, pale blue or yellowish gray. A light dorsolateral stripe may be more or less evident. The sides are brown like the back and similarly marbled. The head is brown or olive above with narrow lines or dots of dark brown, which are most distinct between the eyes and on the temples. The tail is olive or brown, sometimes with irregular dark brown rings. The lower surfaces are everywhere suffused with blue in brightly colored specimens. In others, the central belly, chest, limbs and tail are yellowish white, often suffused with slate or dull black. The most intense blue is on the gular region and on each side of the belly, often shading to blackish blue along the middle of the belly and across the chest. Males have the entire throat deep blue, in a single patch, and females are similarly but less intensely colored.

Scalation. Dorsal scales 43 to 51, average 47.5; femoral pores 14 to 19, average 16.5.

Pl. 58. *Sceloporus occidentalis taylori.* Lake Tenaya, California. A, D, female; B, C, E, male.

Recognition Characters. The characteristic feature of this race is that the blue belly and throat patches are continuous with each other on either side, not separated by a white area on the chest as in many other spiny lizards.

Habitat. "It is stated that in the Yosemite Park this subspecies lives on and beneath boulders and in rockslides on rocky, sunlit slopes in the heavily glaciated region in the upper Merced basin, about Lake Tenaya, and in the head of Tuolumne Canyon" (Van Denburgh). Specimens from lower elevations (4000 feet) in the Park are the Pacific fence lizard.

Habits. Not recorded.

References. Camp, 1916, pp. 66–67 (*Calif.*); Grinnell and Storer, 1924, pp. 21, 626, 628, 629 (*Calif.*); Van Denburgh, 1922, pp. 315–318 (*gen. lit.*).

Scrub Pine Lizard *Sceloporus woodi* Stejneger

(Fig. 21, p. 63; Pl. 59)

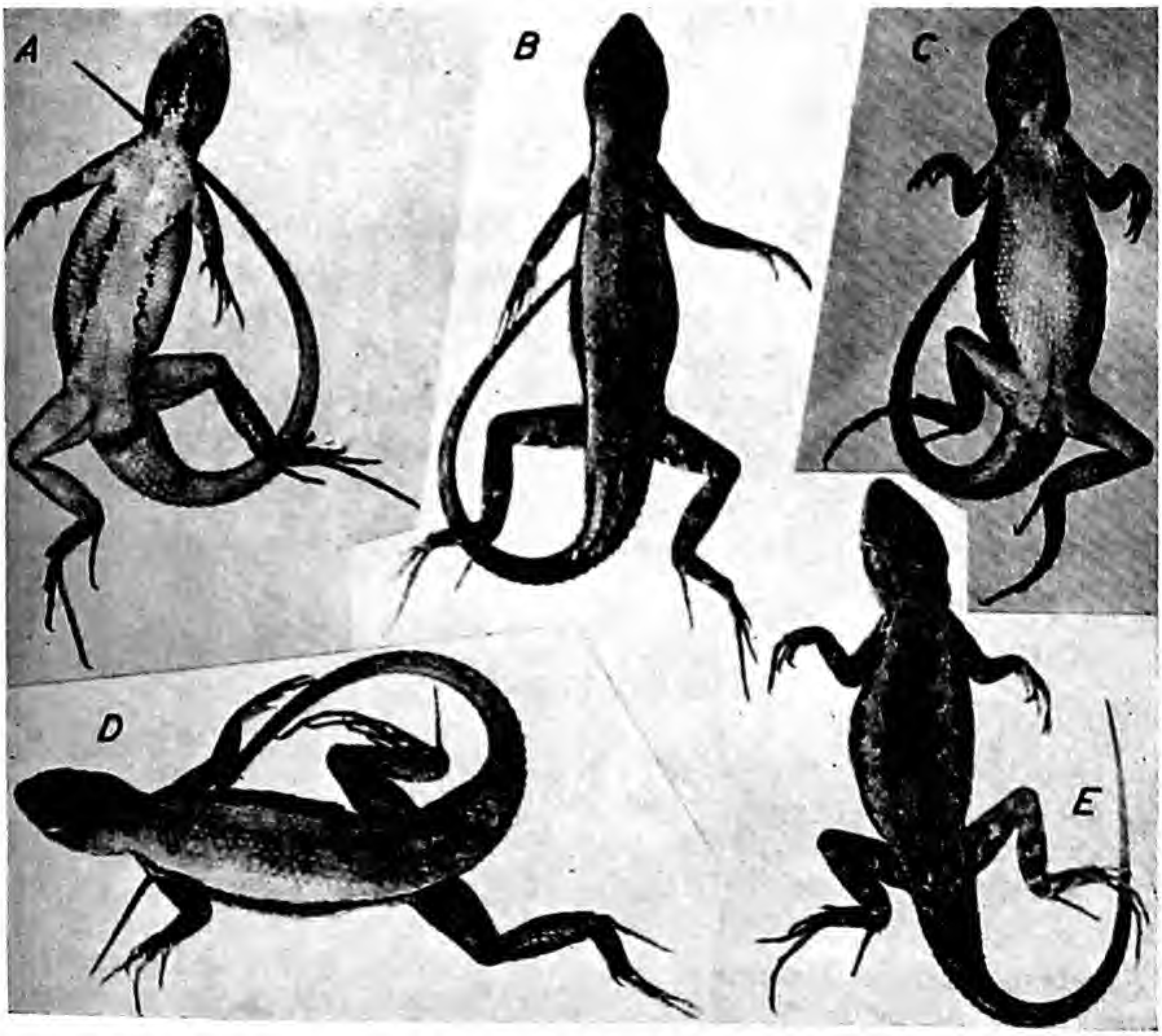
Range. "Spruce Pine ridges of central Florida, the east coast from Malabar south to Hallandale, and extreme southwest Florida" (Stejneger and Barbour, *gen. lit.*). Known from Marion, Putnam, Lake, Polk, Brevard, Indian River, St. Lucie, Highlands, Palm Beach, Collier, Broward, and Dade counties. Type locality—Auburndale, Polk County, Florida. (Map 14, p. 493.)

Size. Specimens of ordinary size are about 45 mm. (1¾ in.) in snout-vent length; the largest recorded has a snout-vent length of 55 mm.; the tail is about 1½ times as long as the body. Size of young at hatching not known.

Color. Adult males light brown or gray-brown above; a well-defined, dark brown band extending from middle of side of neck (upper edge of lateral pouch) to base of tail; a more or less distinct, narrow, longitudinal, light stripe behind the dark stripe on abdomen; dorsal area on body between lateral dark bands with or without 2 series of undulate, dark brown crossbands; when present the bands number about 8 to 10, do not cross the mid-dorsal line, and seldom reach as far as the lateral dark stripes; sometimes darker areas in the lateral stripes correspond with the crossbars on the back; tail light brown above, with or without chevron-shaped dark marks; head light brown, sometimes with fine, transverse, dark lines; limbs, especially the hind legs, sometimes with narrow, white, black-edged crossbars. Ventral surface of head mostly black, the color fading toward lips; a median white stripe, sometimes traversed posteriorly by a black bar, connecting the two black areas; a rather large, azure to cobalt-blue spot on either side in posterior gular region, entirely surrounded by black (narrowly toward middle); a narrow black patch on shoulder, continuous with black border of blue gular patches. Chest and abdomen white or cream, except for a long, lateral, azure to cobalt-blue area on sides of belly, extending from axilla to groin; sometimes a narrow, black border on anteromedial border of the blue areas.

Ventral surfaces of legs white, except for a light yellow area about the femoral pore series.

Adult females are colored like the males above, except that the transverse, undulate, dark bars are more frequently evident. Below they are white, except for a blue area on each side in posterior gular region, sometimes some vague black marks on the throat and gular region, and a small, poorly defined, blue area on either side of belly.



Pl. 59. *Sceloporus woodi.* Lake Placid, Florida. A, B, D, male; C, E, female.

The young lack all markings ventrally but are otherwise like the adults.

Scalation. Dorsal scales 36 to 45; scales around body 40 to 47; femoral pores 14 to 20; scales between pore series 6 to 10; dorsal scales keeled and spiny but not much elevated.

Recognition Characters. The only lizard with relatively large, overlapping scales within the range of the scrub pine lizard is the southern fence lizard. These are very different species; the former has a distinct lateral dark stripe, dorsal scales generally 40 or more, a long fourth toe, first canthal generally

in contact with lorilabials, generally the scales below subocular reduced to 1 row at some point, and auricular lobules 2 to 4 times as large as preceding scales and some extending across ear; it is slenderer and much smaller than the southern fence lizard. The latter has generally less than 38 dorsal scales, a shorter fourth toe, first canthal rarely in contact with lorilabials, generally the scales below subocular forming 2 complete rows, and auricular lobules scarcely if any larger than preceding scales and none extending across ear. There are numerous other differences.

The Bahaman keeled lizard, introduced in the region about Miami, also has large, keeled scales but can easily be distinguished by the absence of femoral pores.

Habitat. "Rosemary scrub, in the open 'strands;' closely associated with the rosemary bushes" (Carr).

Habits. "This is a more cursorial species than *undulatus;* in attempting to avoid capture it rarely dodges about on a log, but more often races across the sand like a *Cnemidophorus.* When cornered it frequently ascends standing trees to a height of twenty or more feet" (Carr).

Problems. There is extraordinarily little published on the habits and life history of this interesting species. Carr's brief notes give more than is to be found elsewhere.

References. Carr, 1940, p. 73, habitat (*Fla.*); Stejneger, 1918, p. 90, description (*Fla.*).

The Graciosus Group

The entire group, of three forms, occurs within the United States; the range of one form extends somewhat into Baja California. The peculiar characteristics are the small size, the terrestrial habits, and the granular scales on the posterior surface of the thighs. They lay eggs.

Sagebrush Lizard *Sceloporus graciosus graciosus* Baird and Girard

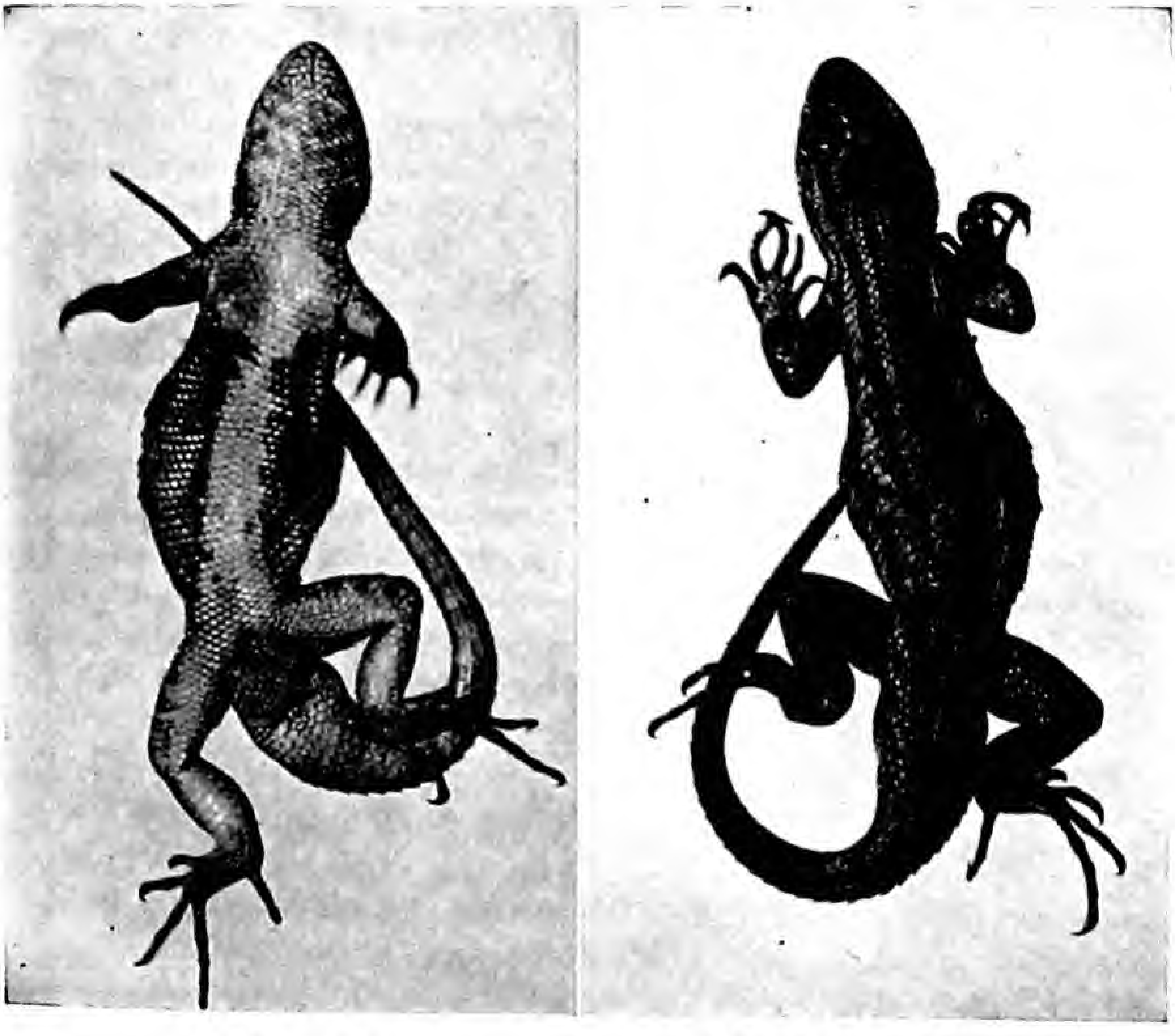
(Fig. 44, p. 89; Pl. 60)

Range. Widely distributed from southwestern Montana to northern Arizona, and western Colorado to extreme eastern California, and from southeastern Oregon to northwestern New Mexico. Type locality—Valley of Great Salt Lake, Utah. (Map 16, p. 495.)

Size. Maximum snout-vent measurement 63 mm. (2½ in.); the tail is 1⅕ to 1½ times as long as the head and body.

Color. Dorsal surface with a series of dark brown spots beginning on each side behind the parietal (or at the corner of the eye) and continuing upon base of tail, separated from its mate by a broad, light brown band; the spots may fuse more or less to form a fairly continuous longitudinal stripe. A

similar series begins posterior to the eye and extends to above the groin; it is separated from the more median row of spots by a fairly distinct light band, and is bordered below by another light stripe extending from the supralabial region to the groin, interrupted somewhat above the forelegs. Below the lateral light stripe is a more or less mottled area merging with the belly pattern. The paravertebral dark stripes or series of spots fuse on



Pl. 60. *Sceloporus graciosus graciosus.* Salina, Utah; male.

the base of the tail to form a series of small, irregular, median spots that soon disappear distally.

In females the ventral surfaces are a nearly uniform white, sometimes with a little mottling of blue on the throat. In males the throat is usually distinctly blue-mottled, but never does it have blue patches on either side. The sides of the belly are dark blue, a center stripe white; rarely the lateral belly patches fuse posteriorly; the chest and ventral surfaces of the hind legs also may be blue, the color frequently confluent with that of the belly.

Specimens from certain parts of Arizona are said usually to have a uni-

color pattern—"so nearly uniform dark brown that only the faintest traces of longitudinal stripes are visible" (Eaton).

Scalation. Dorsal scales 42 to 53, average 48, all keeled, pointed; femoral pores 9 to 16, average 13; supraoculars rather small, separated from superciliaries by parts of the 3 series of small scales, from median head scales by 1 row; scales on posterior surface of thigh rather small; preanal area very well defined, bordered laterally by folds that reach opposite (not posterior to) the ends of the femoral pore series; auricular lobules 6 or 7, small, median ones longest.

Recognition Characters. From other lizards with spiny dorsal scales this species can be distinguished by the very small scales on the posterior surface of the thigh, the absence of blue patches on the throat (the throat may be mottled with blue), the dorsal scales usually between 42 and 52, and the usually distinct dorsolateral light stripes. The species closely resembles specimens of the southern plateau lizard in dorsal pattern, but can be distinguished by the small thigh scales and the absence of blue throat patches. There are other differences, of course.

Habitat. Desert floors and mountain slopes are inhabited, from 5000 to about 8000 feet in elevation. Sagebrush areas are favorite haunts, although they seldom climb into the bushes. Typically ground lizards, they occur mainly on fine gravel soil, but also on sandy or rocky soil. Bouldered regions and forested slopes as well as open flat lands are inhabited. Regions in which mammal holes, rock crevices, or other cover are available are typical, for such places of refuge must be at hand.

Habits. Generally these lizards seek refuge in burrows when alarmed, or under objects such as rocks, twigs, or brush piles. They climb trees or bushes on occasion.

The eggs number 2 to 7, and are laid in early July, hatching by the middle of August.

In Nevada,

> Boyers (MS) made observations on fighting of two individuals of this species. The two lizards darted off a small rock under a sage brush and rolled about six inches down the slope, hanging on to each other with their teeth. They separated and stalked around each other, with throat puffed out, belly lowered, and tail straight out behind, every few seconds displaying by raising and lowering the body by flexing all four legs at once. After a minute, one moved off down slope and left the other (Linsdale, 1940).

As Knowlton has commented, the exact nature of the food of these lizards depends upon the forms that are most abundant; generally the most abundant insects are the chief food items. However, the rather large number of accounts of stomach contents shows a generally strong preference for ants. Some authors find a predominance in grasshoppers and other insect types.

It is certain, nevertheless, that the food is exclusively arthropod in composition, except perhaps for occasional leaves. Even these are thought to have been ingested accidentally with, for instance, lepidopterous larvae which may cling to them rather tenaciously.

Woodbury reports finding nematodes in all stomachs examined.

Problems. The range of this race and the area of intergradation with other races are problems worthy of careful study. The whole species is in need of revision. So far as I can find there are no Montana records, yet the species is generally thought to occur there. There are no Oklahoma records either, although the species is frequently said to occur there; the easternmost localities are in central New Mexico and central Colorado.

References. Burt and Hoyle, 1935, pp. 199–200, Wyoming records (*Kans.*); Cary, 1911, pp. 23, 26, Colorado records (*Colo.*); Cole, 1932, pp. 638–639, food (*Idaho*); Eaton, 1935, pp. 12, 14–15, natural history (*Ariz.*); Gordon, 1939, p. 67, Oregon records (*Ore.*); Grinnell, Dixon, and Linsdale, 1930, pp. 144–145, habits, habitat, California (*Calif.*); Knowlton, 1932, p. 46 (*lit. cit.*); *idem*, 1934, pp. 1000–1001 (*lit. cit.*); *idem*, 1936, pp. 9–10 (*lit. cit.*); *idem*, 1938, pp. 237–238 (*Utah*); *idem*, 1942, p. 602 (*lit. cit.*); Knowlton and Janes, 1931, pp. 140–142 (*lit. cit.*); *idem*, 1932, pp. 468–470 (*lit. cit.*); *idem*, 1933, pp. 1011, 1014–1015 (*lit. cit.*); Knowlton and Thomas, 1934, p. 258 (*lit. cit.*); *idem*, 1934, p. 264 (*lit. cit.*); *idem*, 1936, p. 65 (*lit. cit.*) [all references by Knowlton and collaborators are on food, Utah]; Linsdale, 1938, p. 27, habitat (*Nev.*); *idem*, 1940, pp. 226–227, habits, habitat, Nevada records (*Nev.*); Pack, 1921, pp. 63–66, food, Utah (*lit. cit.*); Richardson, 1915, pp. 405, 419–421, taxonomy, habits (*Nev.*); Ruthven and Gaige, 1915, pp. 21–23, habits, habitat, Nevada (*Nev.*); Ruthven and Stuart, 1932, p. 3, hatching period (*lit. cit.*); Slater, 1941, p. 92, Idaho records (*Idaho*); Stuart, 1932, pp. 7–13, 19, 20, 23–25, 28, 30, habits, habitat (*Utah*); Taylor, 1912, pp. 324, 335, 336, 340, 349–350, habits, habitat, food Nevada (*Nev.*); Van Denburgh 1922, pp. 273–280, pl. 20, description, range, natural history (*gen. lit.*); *idem*, 1924, pp. 191, 205, New Mexico records, synonymy (*N.M.*); Woodbury, 1931, pp. 12, 37, 40–42, description, habits, habitat, food (*Utah*); *idem*, 1932, pp. 13–14, food (*Utah*).

Northern Mountain Lizard *Sceloporus graciosus gracilis* Baird and Girard

(Pl. 61)

Range. Central southern Washington, Oregon east of the Cascades except the southeastern corner, and the Sierra in California south to Ventura County. Type locality—Oregon. (Map 16, p. 495.)

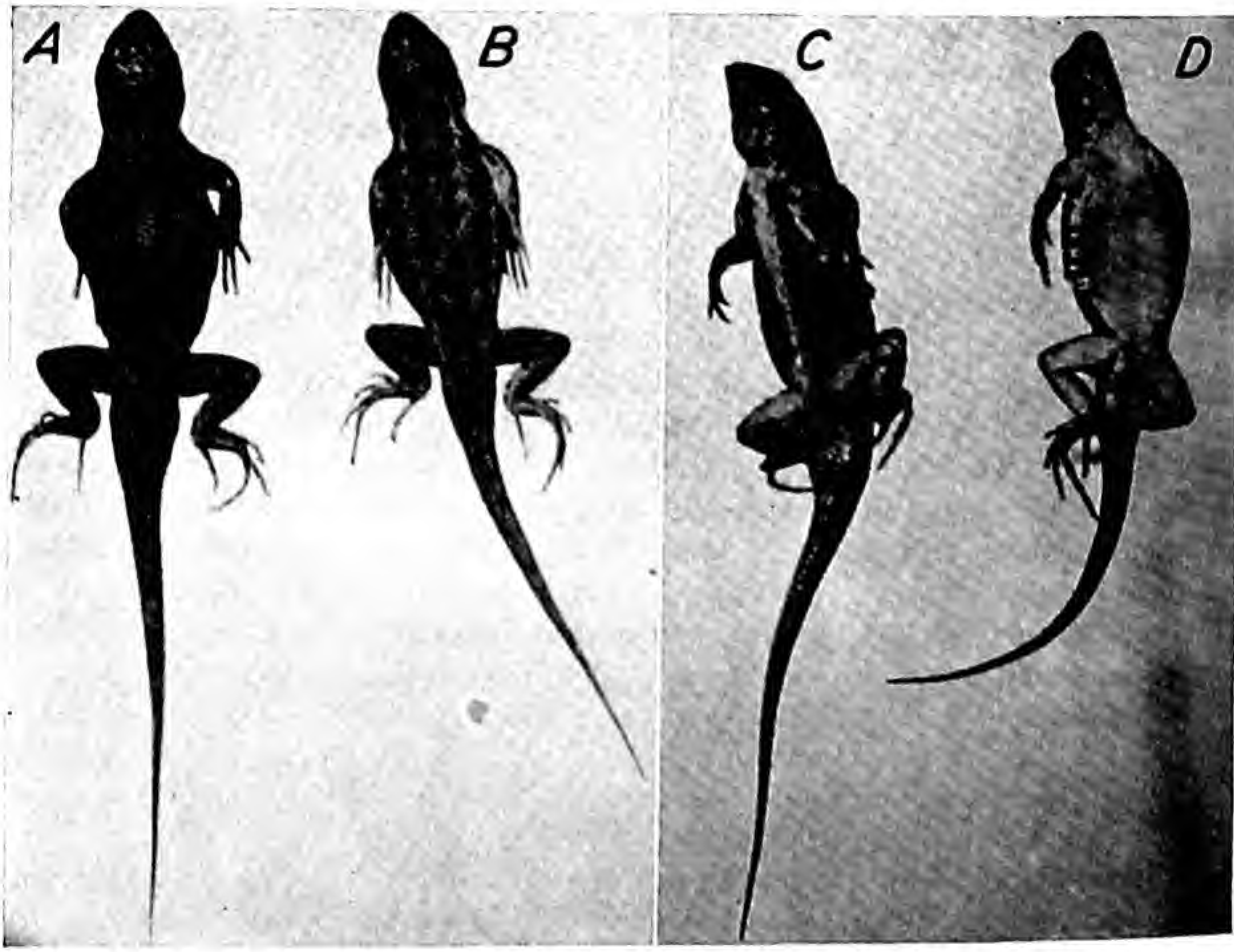
Size. Maximum snout-vent measurement 58 mm. (2$^5/_{16}$ in.), thus somewhat smaller than *g. graciosus*.

Color. Much as in *g. graciosus*. The longitudinal light stripes, and the whole pattern as well, are less distinct than in the sagebrush lizard. In males the throat is a more or less uniform blue, this color sometimes tending to

form oblique lines; the sides of the belly are blue, and the blue areas may be black-bordered medially. In females the throat and sides of belly may or may not be bluish; a band of bright reddish orange may be present on the lower sides of the body.

Scalation. Much as in the sagebrush lizard, except that the dorsal scales are considerably smaller, averaging about 61 from occiput to base of tail (range 52 to 68); femoral pores 12 to 20.

Recognition Characters. The only other lizard of similar appearance oc-



Pl. 61. *Sceloporus graciosus gracilis.* Shaver Lake, near Fresno, California. A, C, male; B, D, female.

curring in the same area as the northern mountain lizard and lacking a granular fold across the ventral surface of the neck is the Pacific fence lizard. These two can be distinguished by the size of the dorsal scales (larger in the fence lizard, 46 or less), by the head-body size (the fence lizard reaches 3 inches, the mountain lizard not 2½ inches), by the belly color in males (deep blue, much of ventral surfaces colored in the fence lizard), and so on. From the adjacent relative, the sagebrush lizard, this form is distinguishable with difficulty. The smaller size of the dorsal scales is the chief difference.

Habitat. Relatively little has been recorded. In southwestern Oregon Fitch

records that "within the area the mountain swift is limited to Transition Life Zone. It seems to be restricted further to localities where dry, open ground is available. This habitat is present on hillsides so precipitously steep that nearly all debris is washed away, and the ground is swept bare. The lizards may be locally abundant in such places. Golden Oak is usually the dominant plant in this habitat."

Habits. In most of the localities where Fitch collected the mountain lizard,

the fence lizard was also present, but not in great numbers. The competition of this larger species may be a limiting factor in the distribution of the smaller one. Both in the wild and with caged individuals, I have noted that the mountain swifts are wary of the larger fence lizards. Males of the former species made threatening displays in the presence of the latter, but retreated when these approached too near. Fence lizards seemed to ignore the presence of the smaller swifts.

Two female mountain swifts collected at Rainie Falls, on May 12, 1934, each contained five developing ova. These and other breeding females seen on the same date had conspicuous salmon colored markings along the sides and neck.

Richardson records specimens with 2 to 4 eggs in the abdomen. Van Denburgh says they are laid in June and July, and measure about 7 x 13 mm.

Very recently Stebbins has published extensive observations on the natural history of *g. gracilis* in the region of Lassen Volcano, California. He summarizes them as follows:

Each lizard is restricted in movement within the habitat. Females are more sedentary than males. The latter exhibit a wandering tendency. The average maximum distance traversed by females during the activity period was 59.0 feet while that for males measured 82.1 feet.

Territories of the mountain swift exhibit a central point of predominant activity which frequently may center about a fallen tree, a bush, or a prominent rock pile. Within the general region occupied by a given lizard this focal point may be shifted. Seasonal changes in degree of insolation may in part explain such movements of activity centers. Territories may be maintained from one year to the next.

Intraspecific competition appears to be mild. No contests over territories were observed during the 1942 period of study.

Interspecific competition is unimportant at least as far as other rival lizards are concerned. The alligator lizard *Gerrhonotus coeruleus palmeri* is the only other species in the region.

The period of activity is presumed to be about 6 months in duration, probably extending from the latter part of May to October.

Egg-laying presumably occurs in June and early July. Young appeared late in August and in September. When first procured they measured about 25–27 mm. in length from tip of snout to cloaca. Maximum adult size was 55.5 mm. for males and 57.5 mm. for females.

Carpenter ants (*Camponotus* sp.) are an important item in the diet. Ladybird

beetles (Coccinellids) have been recovered in the stomach contents. Immature seeds and leaves of *Lupinus obtusilobus* probably are taken also.

Some adults showed evidence of memory over a period of 3 weeks, since when confronted with the collector's noose subsequent to the initial capture they were exceedingly wary.

Problems. The range, natural history, and area of intergradation with the sagebrush swift are all problems that deserve study. There is a record from British Columbia, but I can find no corroboration for it.

References. Fitch, 1936, pp. 641–642, habits, as quoted, Oregon and California (*Ore.*); Grinnell and Storer, 1924, pp. 21, 627, 628–630, habits, habitat (*Calif.*); Owen, 1940, p. 169, Washington records (*Wash.*); Richardson, 1915, p. 421 (*Nev.*); Stebbins, 1944, pp. 233–245 (*Calif.*); Van Denburgh, 1922, pp. 280–285, description, range, habits, etc. (*gen. lit.*).

Southern Mountain Lizard *Sceloporus graciosus vandenburgianus* Cope (Pl. 62)

Range. The Coast Range of southern California, from Los Angeles County southward; Sierra San Pedro Mártir in Baja California. Type locality—summit of Coast Range, San Diego County, California. (Map 16, p. 495.)

Size. A little larger than the other two races, reaching 65 mm. (2$\frac{9}{16}$ in.) snout to vent.

Color. As in the sagebrush swift, except for the ventral coloration of the males; in these the entire ventral surfaces are bright indigo blue, except for a more or less black line along the middle of the belly and across the chest, and lighter gray extremities on the limbs and tail. The sides are salmon pink in life, but this color quickly fades.

Scalation. As in the sagebrush lizard, except the dorsal scales smaller, averaging about 55 (range 48 to 66). Femoral pores 13 to 19.

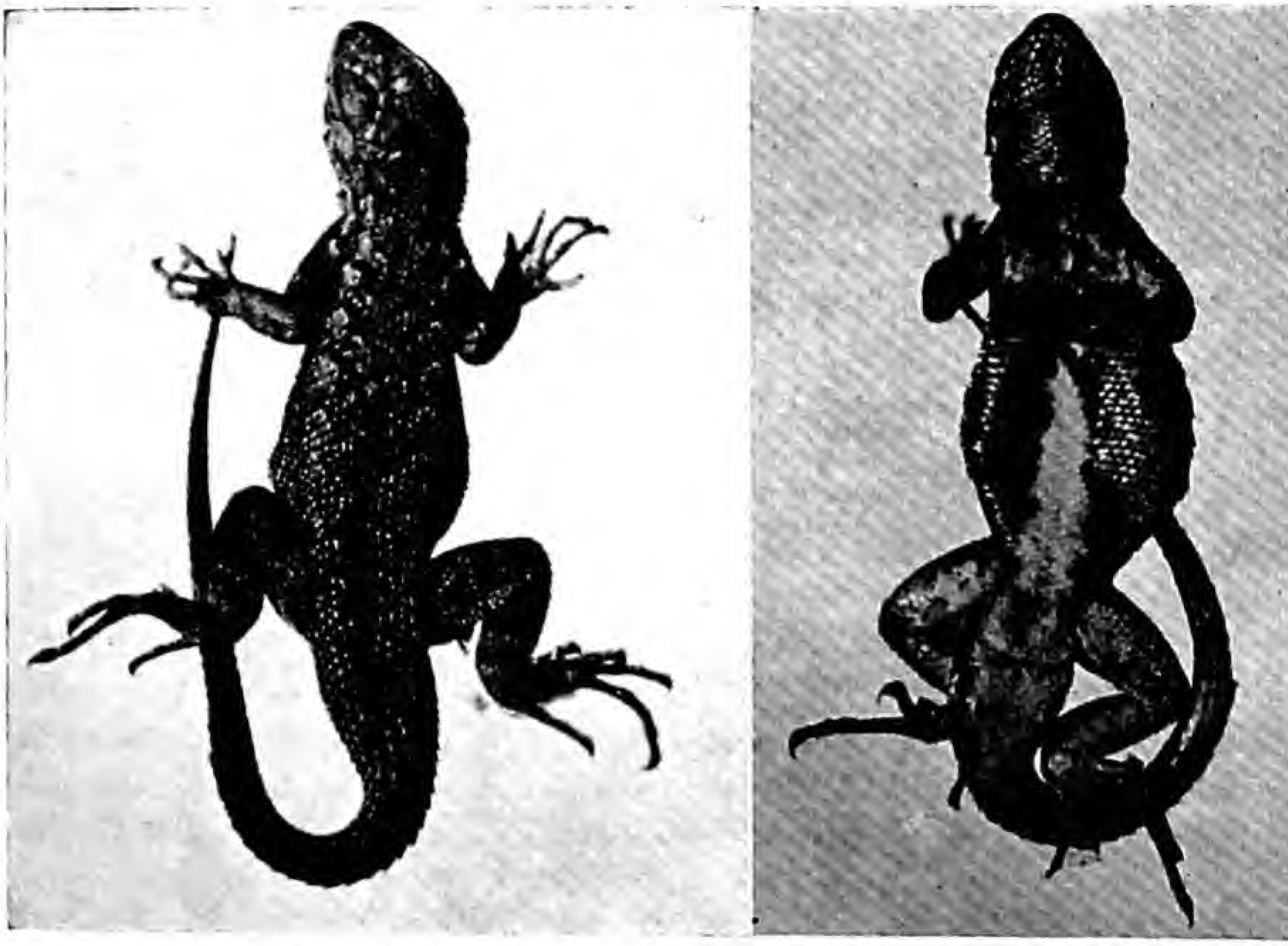
Recognition Characters. From all other lizards of generally similar appearance occurring in the same area, the southern mountain lizard can be distinguished by the absence of a gular fold and by the small size, yet spinose character, of the dorsal scales, which in others number less than 48 from occiput to base of tail.

Habits and Habitat. According to Klauber,

> this is a mountain form, in southern California probably attaining its greatest abundance in the belt between 5,000 and 6,000 ft. altitude. Here it is very plentiful, far exceeding all other lizards. It reaches an altitude of at least 9,000 ft., but is progressively less common above 6,000 ft. As it rarely, if ever, descends below 4,000 ft., the southern California range is broken into a series of montane islands (Klauber).

These lizards are generally found perched on logs, stumps, or rocks. When

frightened they generally take refuge under logs, but do not scorn as hiding places, stones, ground holes, or even pine needles, leaves, or other debris. They occasionally run up trees. They are quick and difficult to catch, unless they can be driven into grass, where they become entangled so that one can easily secure them (Klauber).



Pl. 62. *Sceloporus graciosus vandenburgianus.* Laguna Mountains, San Diego County, California; male.

Grinnell has commented upon the surprising ability to jump from rock to rock and to dart about after insect prey. The food consisted largely of ants in the specimens whose stomachs were examined. This myrmecophilous habit is common to the whole group of races, apparently.

Problems. This race is better defined geographically than the others of *graciosus*, but its life history is the least well known of all.

References. Grinnell, 1908, p. 161, habits, habitat (*Calif.*); Klauber, 1939, pp. 83, 90, habits, habitat (*Ariz.*); Linsdale, 1932, p. 364, habitat (*lit. cit.*); Van Denburgh, 1922, pp. 286–290, description, habits, habitat (*gen. lit.*); Wood, 1935, pp. 166, 167, parasites (*Calif.*).

The Climbing Utas

Genus *UROSAURUS* Hallowell

All the forms of this genus seemingly abhor a horizontal position. They are notorious climbers and inhabit trees and bushes, or boulders and cliffs. If they descend to the ground, it is not for extended wandering; they perform their mission quickly on the surface (food getting or migration) and then either retreat into holes in the ground or climb back to some elevated

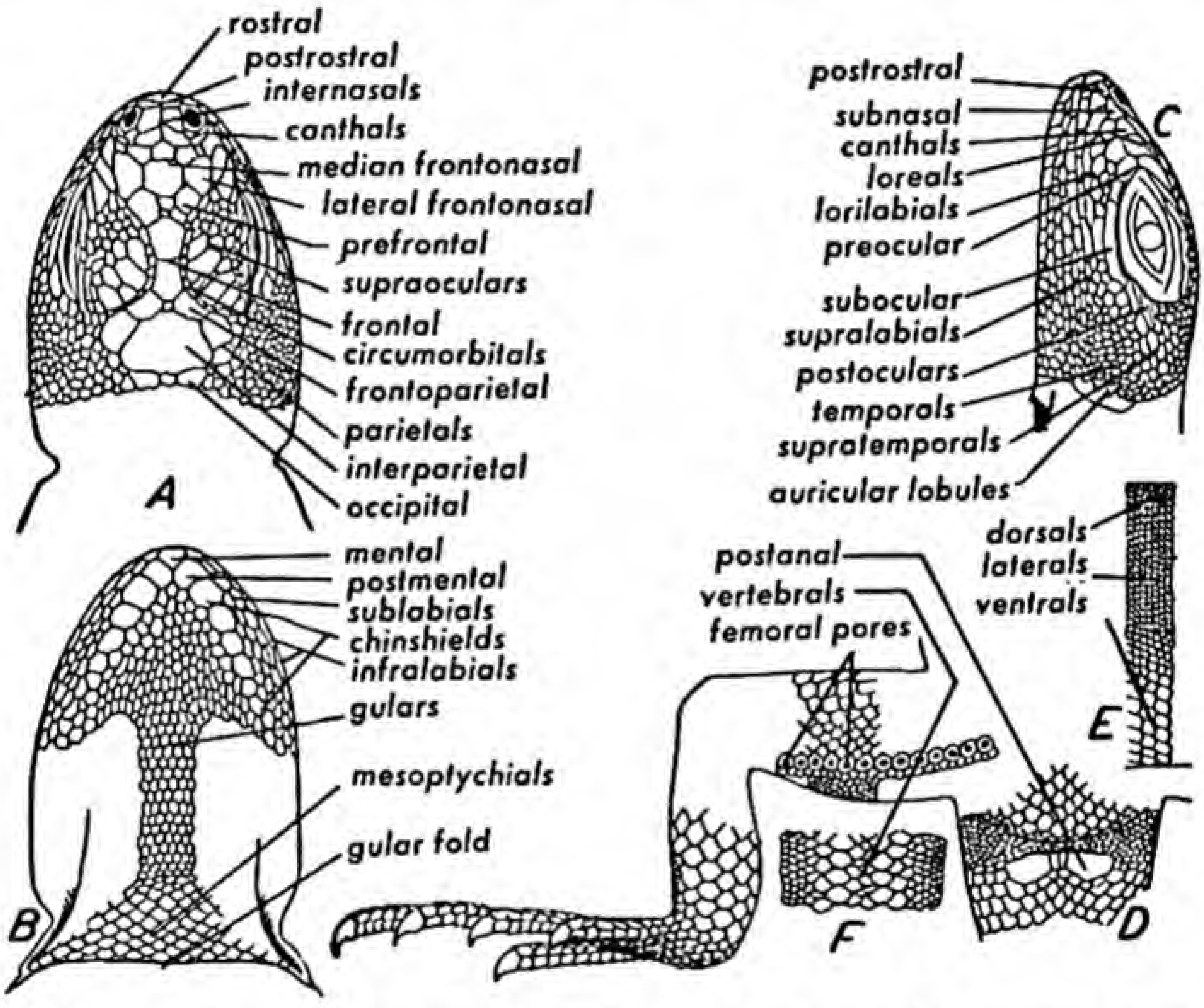


FIG. 79. Typical scutellation in *Urosaurus*, from *U. ornatus levis*, Tierra Amarilla, New Mexico. A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of side of body; F, section of dorsal surface of body. From Cope.

object. It may actually not be the horizontal position they dislike so much as the inability to use fully their faculties for protection. Many arboreal mammals show the same sort of predilection for trees and the same uneasiness on the ground, even though perfectly capable of normal movements on the ground. It is to be noticed, however, that all these scansorial creatures are poor runners: they either lack endurance for that type of exertion, or they are incapable of high speed, or both. Thus the climbing propensities and extreme development of protective coloration preserves these animals

which otherwise might be incapable of long survival in the face of better-prepared competitors. That this feature of habits is carried through all the species of so large a group as this is further evidence that habits may very frequently be as stable and significant as morphology. In many cases, of course, as has long been known, one is the reflection of the other.

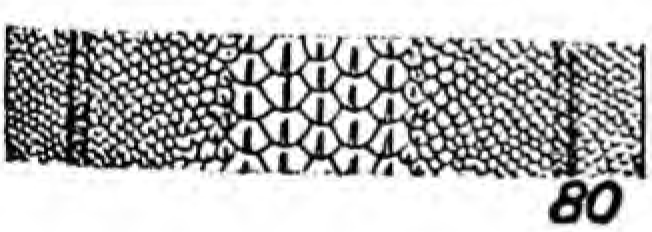
The genus, as recently monographed and emended, consists of twenty species and subspecies, nine of which occur within the United States. The genus ranges from Washington to southern Mexico at the Isthmus of Tehuantepec, and from Baja California and western California to central Texas; south of the United States border it is almost exclusively confined to the Pacific side.

All members are of small or medium size; they are diurnal in habit and egg-laying.

A ready means of identification of members of this genus is something yet to be desired. Oliver (1943, *lit. cit.*) shows that at least some of the differing characters in the three forms he studied (Mexican) of the genus can be treated numerically—a great boon to any manipulation of these races. It is perhaps not too much to expect that a similar study of the United States species and subspecies will produce comparable results for them as well. Until then the allocation of many specimens must remain a somewhat arbitrary matter. Mittleman's arrangement is followed here as the best now known, although he as well as others admits that the characters as thus far described are not as precise as desirable. Some details of the scutellation of a typical member of the genus are shown in Fig. 79.

KEY TO SPECIES OF *UROSAURUS*[5]

1. Tail at least twice the length of head and body combined; dorsals becoming abruptly smaller on either side of the central band of enlarged scales (Fig. 80) .... *graciosus* (p. 259)
   Tail not so long; dorsals becoming abruptly smaller or not 2



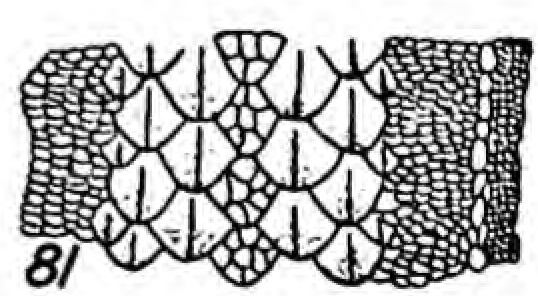


FIG. 80. *Urosaurus graciosus*, strip of scales around middle of body. From Van Denburgh.

FIG. 81. *Urosaurus ornatus linearis*, strip of middorsal scales. From Burt.

2. Dorsal scales on median line not smaller than scales in adjacent rows; all dorsal scales very small .... *microscutatus* (p. 262)

[5] Chiefly from Mittleman, 1942, pp. 127–133 (*gen. lit.*).

Dorsal scales on median line small and separating 2 parallel series of considerably enlarged scales (Fig. 81) 3

3. Three or 4 series (rarely 2) of enlarged dorsals on either side of the vertebrals; enlarged dorsals not strongly keeled, not prominently imbricate; dorsolateral and lateral tubercles not effecting a diagonal arrangement; dorsolateral and lateral folds variable, but usually absent or poorly developed; general appearance not at all rugose ... 4

Two principal series of enlarged dorsals on either side of the vertebrals; enlarged dorsals strongly keeled and prominently imbricate; dorsolateral and lateral tubercles usually well developed and effecting a diagonal arrangement; dorsolateral and lateral dermal folds present; general appearance rugose 5

4. Enlarged dorsals rather flat, very weakly keeled, slightly imbricate, or just as often pavemented (juxtaposed); dermal folds absent or rudimentary; dorsal basal tail scales barely or not at all differentiated from the lateral basal scales .... *ornatus levis* (p. 266)

Enlarged dorsals more convex, more strongly keeled, more imbricate; dermal folds often present, with a fair degree of development; dorsal scales on the basal portion of tail abruptly differentiated from the much smaller, lateral, basal scales .... *ornatus wrighti* (p. 274)

5. Enlarged dorsals often irregularly arranged; lateral tubercles not effecting a diagonal arrangement; average size less than 45 mm. snout to vent 6

Enlarged dorsals regularly arranged in parallel series on either side of the vertebrals; tubercles in parallel diagonal series; average size greater than 45 mm. from snout to vent 7

6. Scales of inner series not twice as large as those of the outer series; largest of the dorsals smaller than enlarged femorals and tibials; ventral interhumeral and interfemoral areas immaculate, or but lightly stippled .... *ornatus schmidti* (p. 271)

Scales of inner series almost twice as large as those of outer series; largest of the dorsals equal to or larger than the enlarged femoral and tibial scales; ventral interhumeral and interfemoral areas heavily spotted .... *ornatus ornatus* (p. 264)

7. Largest of the dorsals equal to or larger than the enlarged femorals; vertebrals extending onto the basal portion of the tail for a distance equal to half or slightly more of the length of the femur; the entire gular region in males, except the sublabials, an intense blue; head length/head width ratio averaging 81 per cent *ornatus chiricahuae* (p. 266)

Largest of the dorsals inferior in size to the enlarged femorals; vertebrals extending only onto the rump, or but slightly farther; no uniform intense blue color present in male gular region; head length/head width ratio averaging 75 per cent or less 8

8. Enlarged dorsals separated into 2 parallel series by the width of the vertebral series, which is greater in width than the broadest of the enlarged dorsals; prefrontals and frontonasals usually 3 each; general coloration pallid, light tan above, whitish below, males with

bright blue abdominal patches; average head length/head width ratio 75 per cent; average length, snout to vent, 55 mm. .... *ornatus symmetricus* (p. 273)

Enlarged dorsals separated by a vertebral series whose width is less than that of the largest of the dorsal scales; prefrontals 2, rarely 3; frontonasals 5; general color variable, but usually dark brown or gray with dark crossbands, and heavily stippled, spotted, or blotched ventrally; abdominal patches in males dark blue to indigo; average head length/head width ratio 71 per cent; average length, snout to vent, 46 mm. .... *ornatus linearis* (p. 268)

Long-tailed Uta *Urosaurus graciosus* Hallowell

(Figs. 47, 48, p. 90; Fig. 80; Pl. 63)

Range. The Colorado River Valley from extreme southern Nevada to the Gulf of California including extreme eastern California and Baja California and extreme western Arizona and Sonora. Type locality—"Lower California" (Southern California). (Map 17, p. 495.)

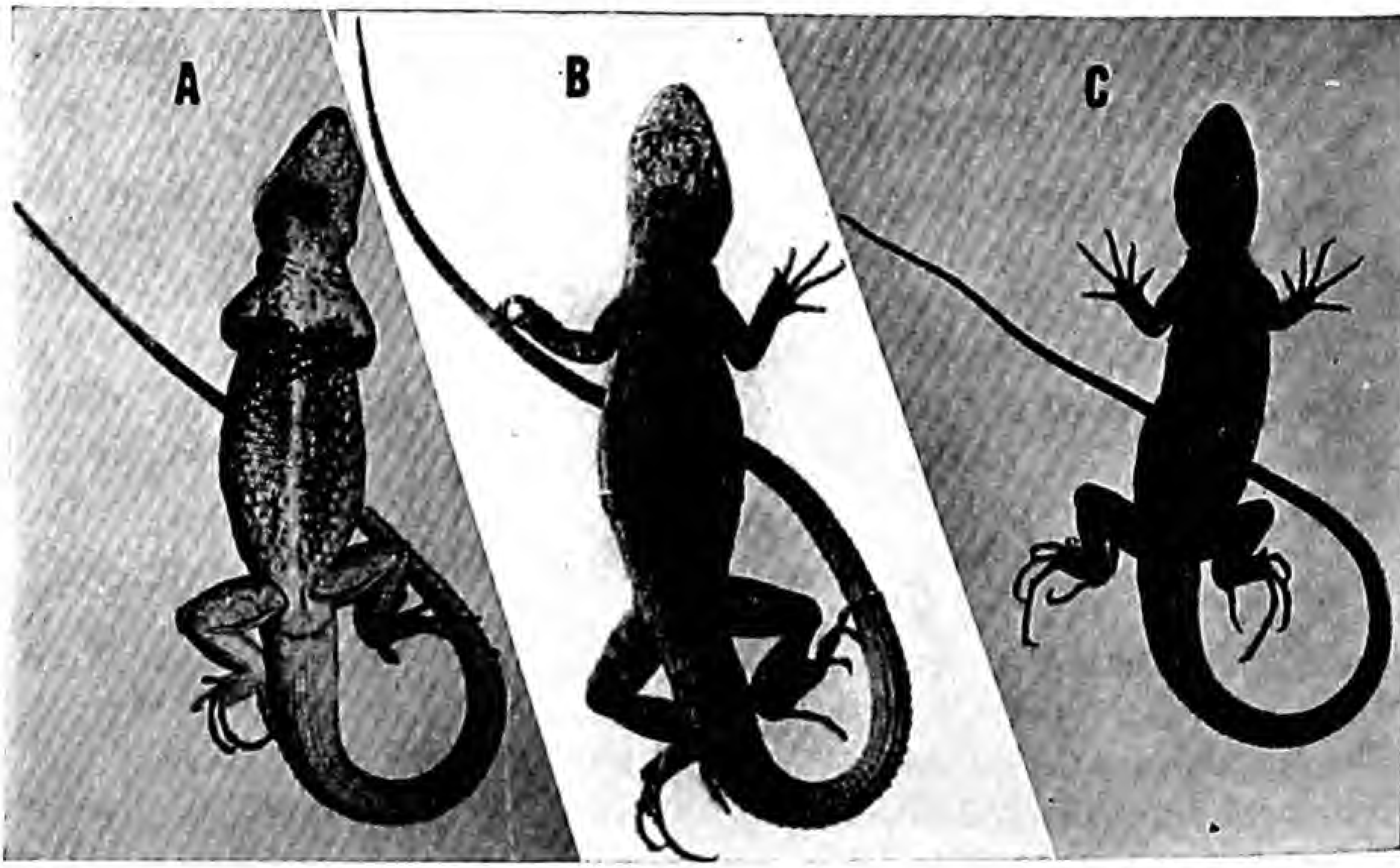
Size. A species of moderate size reaching a maximum snout-vent length of about 59 mm. (2⁵⁄₁₆ in.). The tail is from 2¼ to 2½ times as long as the head and body.

Color. Light gray to gray-brown above. Head with an intricate pattern of fine, dark lines. Body with 8 to 10 narrow, dark gray, transverse bands extending from near the median line to the middle of the sides of the body. The bands of the opposite sides usually coincide in position, but may not. The one above the shoulder is frequently more prominent and darker than the others. A usually ill defined light line extends from the supralabial region above the arm and to the groin; sometimes a dark line borders it above. Poorly defined, dark and light streaks usually are present on the neck. A dark line extends from the posterior corner of the eye, passing above the tympanum, to the neck, sometimes continuing posteriorly on a dark line above the lateral light line. In females the ventral surfaces are slightly dusky, sometimes with short, dark streaks on the chest and sides of belly. Males usually have the throat somewhat streaked. The throat is not blue. There are pale to navy-blue patches on either side of the belly, however, extending from the axilla nearly to the level of the groin. In young specimens the patches are short but they become more extensive posteriorly with increasing age. The blue also becomes darker in larger specimens. Small light flecks, white or blue in color, dot the blue patches; in old specimens they are very prominent. The blue areas do not meet medially, but are separated from each other by the width of 2 to 4 scales.

Scalation. A median, longitudinal area of enlarged scales extends from a little anterior to the shoulders posteriorly to the tail, there merging with the large, dorsal caudals (Fig. 80). A few scales in the median row or two are

somewhat reduced in size. Across the rump all the scales are of nearly equal size, except those immediately bordering the legs. There is a distinct, granular, gular fold, overlapped by larger scales. The frontal is divided. Femoral pores 9 to 14. Enlarged postanals present in males. Postfemoral pocket regularly absent.

Recognition Characters. If the tail is complete and unregenerated, this species can be recognized at once by the long tail, considerably more than twice the length of the head and body. This is true of no other similar western United States species save *Streptosaurus mearnsi*, which has all the



Pl. 63. *Urosaurus graciosus*. A, Colorado Desert, California; male. B, 17 miles west of Yuma, Arizona; male. C, Colorado Desert, California; female.

scales on the body of equal size and is much different in appearances. In case the tail is incomplete, the species can be distinguished from its nearest relatives with several series of enlarged dorsal scales by the uniform scales across the rump, the only slightly smaller size of the middorsal series of scales as compared with adjacent series, and the discrete, separate, blue, belly patches and the absence of blue on the throat in males. In *o. symmetricus*, a very similar lizard occurring in the same general area with *graciosus*, the scales across the rump consist of about 2 median series of small scales, then 2 or 3 series of enlarged scales on either side of these, then an area of small scales, another of enlarged scales, and then the small scales bordering the legs. These also usually have a postfemoral pocket, while *graciosus* does not.

Habitat. This species is almost exclusively confined to bushes and small

trees, such as mesquite and creosote. Near Blythe Junction, California, "some were in creosote bushes on the open desert, some in squaw-tea on the sand dunes, and some on the branches of smoke trees in the washes" (Camp).

Habits. Generally specimens are seen clinging head downward on twigs, where they remain motionless and very inconspicuous until disturbed or convinced that movement is safe. Camp says that they sun themselves on the outermost twigs but drop to larger branches at the first sign of danger, "playing possum" there where they are perhaps less conspicuous than on the outer twigs. When pursued into the bush and unable to rely upon their protective coloration to escape, they generally dash to the ground and into holes that almost invariably are present. These holes probably serve in other ways than as temporary refuges—although they sleep at night in the bushes —for Cowles has found them in hibernation in the ground at depths of 6 to 12 inches. Very likely they utilize these burrows, although the possibility that they burrow on their own initiative is not to be discounted completely. It is known, however, that burrowing is no usual trait.

Food hunting is done on the ground as well as in bushes, but never do the lizards leave their favored arboreal haunts for any length of time. When alarmed on the ground, they first jump into the bushes to effect concealment. The period of activity covers the whole day, from early morning to dark. Their activity during the middle of the day is reflected in their high threshold of color changes; the dark phase disappears at the extraordinarily high temperature of about 105° F., the lizards transforming into the light phase. This change occurs almost completely in response to temperature change, not to illumination change, at least experimentally. Psychological stimuli may cause color changes at moderate temperatures, but background color is said not to do so, except indirectly as the temperature of the background may vary.

Under experimental conditions, at a temperature of about 48° F. "on January 2, 1924, the entire ventral as well as the dorsal surface appeared to be washed with gray, the ventral patches almost black and the throat spot a faint pinkish. In the light phase the dorsal surface was light, the ventral patches bright green, and the throat spot almost flame color" (Atsatt).

Several authors have commented upon the very great extent of color change of which these lizards are capable, saying that it "is greater and more rapid than in any other Californian reptile. A nearly white male held in my hand changed rapidly in two or three minutes to yellowish black with cross bands on the back, the originally light greenish ventral patches became blue, and a yellow spot appeared under the throat" (Camp). The bright colors of copulation were described by Camp as follows: "The female was . . . light orange with two longitudinal black stripes down the center of the back. The male was grayish over the back and yellowish on the sides."

Hibernation occurs but the torpidity assumed is variable. A specimen re-

covered by Cowles at a depth of 6 inches was moderately active, while another found at 12 inches was semidormant. "The specimen from a 6 inch depth was shedding its skin, a condition strongly suggesting considerable winter activity." As early as February 15 they may emerge on warm days.

The food consists of insects, and possibly plant matter. Little is known of the breeding habits. The copulation mentioned above was observed on July 13.

Collecting specimens requires patience. Each twig and branch should be examined carefully, until all have been surveyed; frequently two or three lizards to a bush will be found. Bogert (in Cowles and Bogert) hunted them very successfully at night, following each twig with a light beam until they were revealed by the flash of their white bellies. He secured seventy-two specimens in one evening "in creosote bushes bordering the stream leading from the Boulder City sewage disposal plant. . . ."

Problems. The relationship of this species to *o. symmetricus* is a problem not yet satisfactorily solved. Careful observations and comparisons of the two in the field are much to be desired. The breeding habits are poorly known.

References. Atsatt, 1939, pp. 253–254, fig. 6, color changes (*lit. cit.*); Camp, 1916, p. 525 (*Calif.*); Cowles, 1941, p. 130, hibernation (*lit. cit.*); Cowles and Bogert, 1936, pp. 37–38 (*Ariz.*); Klauber, 1939, pp. 33, 76, 82, 85, 89, table 15, habitat, habits (*Ariz.*); Mittleman, 1942, pp. 144–145, pl. 7, description, range, taxonomy (*gen. lit.*); Van Denburgh, 1922, pp. 212–216, pl. 17, description, range, habits, habitat (*gen. lit.*).

Small-scaled Uta *Urosaurus microscutatus* (Van Denburgh)

(Fig. 54, p. 91; Pl. 64)

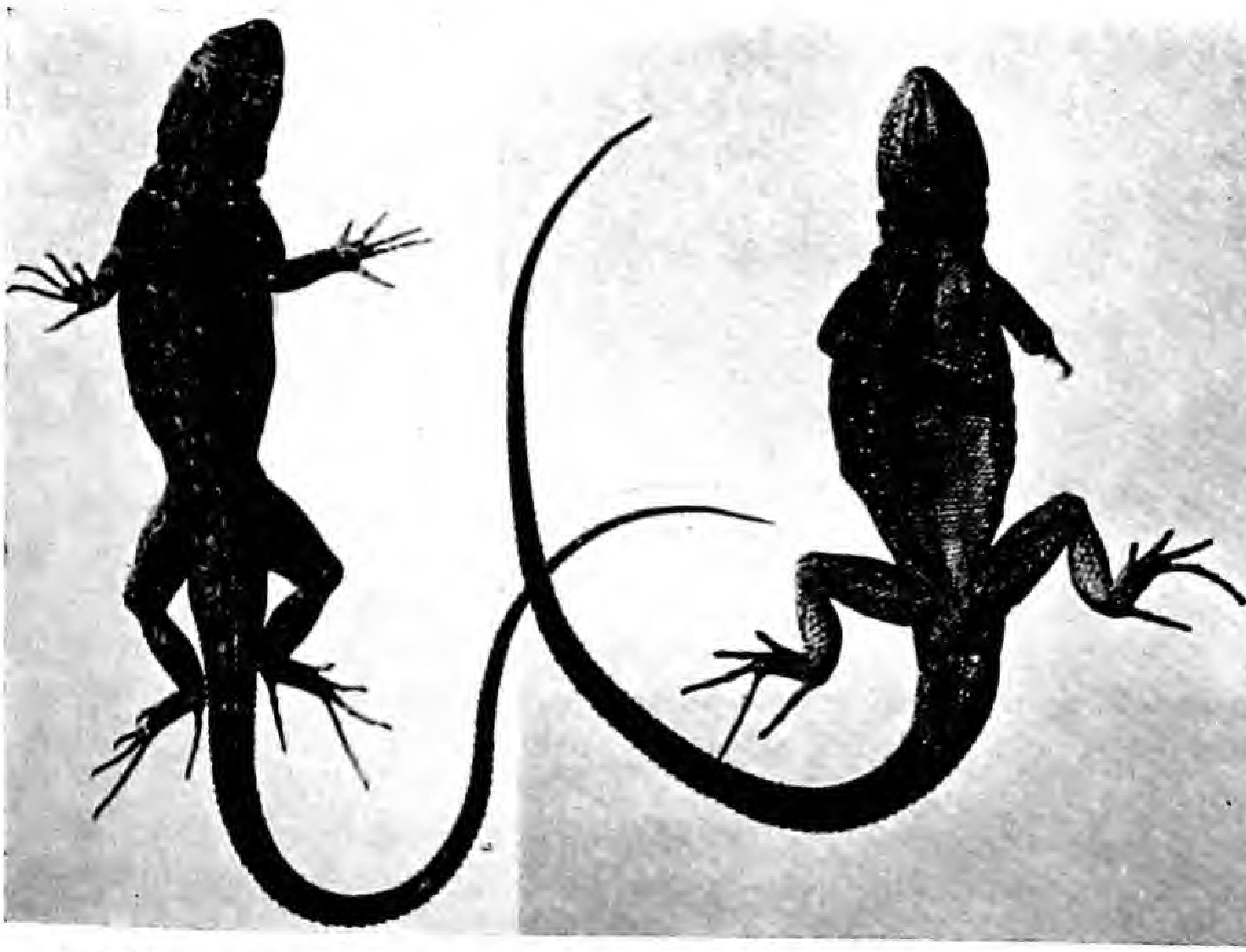
Range. Baja California and adjacent islands except in the Cape region, and just across the United States boundary in California. Type locality—San Pedro Mártir Mountains, Baja California. (Map 17, p. 495.)

Size. A rather small species, reaching a maximum snout-vent length of about 48 mm. (2 in.), average about 40 mm. in adults. The tail is slightly less than twice the head-body measurement.

Color. Usually rather dark gray above, sometimes lighter. The back may be uniform, or more frequently has from 7 to 9 black, transverse bands on either side of the middorsal line; sometimes these extend well onto the sides of the body, but more frequently they are very short. The shoulder band is the most prominent of all and has a conspicuous, broken, light border posteriorly; some of the other bands also may have small light spots on their posterior borders. In females the ventral surfaces are white, with numerous small black flecks. In males a central, posterior part of the gular region is pale blue, and the rest of the gular area is white, or suffused with

gray. The remainder of the ventral surfaces are gray, darker in larger specimens, except for a large blue patch on either side of the belly; these patches are frequently confluent medially and extend from the axilla to the groin.

Scalation. All dorsal and lateral scales very small, but those in a rather narrow, middorsal area are slightly enlarged. Caudal scales much enlarged, heavily keeled, strongly mucronate. A distinct, granular gular fold. Frontal



Pl. 64. *Urosaurus microscutatus.* Palm Canyon, San Diego County, California; male.

entire (Fig. 54). Postanal scales enlarged in males. Femoral pores 10 to 15. A deep postfemoral pocket.

Recognition Characters. The granular gular fold, normal (not diagonal) labials, and the entire frontal will distinguish this species from all other lizards of the United States that look anything like it. No other *Urosaurus* or *Uta* in the United States has an entire frontal

Habits and Habitat. Klauber says this

is essentially a rock dweller, where it partly, but not entirely, replaces the omnipresent *Uta stansburiana.* When frightened it usually seeks refuge in ground holes. While most prevalent on the desert slope of the mountains of San Diego County, it has been found on the coastal side, at such points as Cottonwood and Deerham Flat. Further south in Lower California it is more plentiful on the coastal side of the mountains; I found it rather common at such places as Ojos Negros and

Rio de las Flores. As far as I know Borego Palm Canyon, San Diego County, is the most northerly point where this species has been observed in the United States.

In Baja California the habitat is not so restricted; Linsdale records it in numerous types of localities.

Problems. The variation, particularly in the color of the throat region, is in need of study; the color variation should be noted on live specimens. The natural history is largely unknown.

References. Klauber, 1939, pp. 65, 89, habits (*Ariz.*); Middleman, 1942, pp. 159–162, fig. 11 (map), description, distribution, taxonomy (*gen. lit.*); Van Denburgh, 1922, pp. 219–221, description, distribution, synonymy (*gen. lit.*).

Texas Tree Uta *Urosaurus ornatus ornatus* (Baird and Girard) (Pl. 65)

Range. Central Texas, from Brown to Valverde County, and probably adjacent Mexico. Type locality—Rio San Pedro (Devil's River), Val Verde County, Texas. (Map 18, p. 496.)

Size. Probably reaches a maximum at about 46 mm. (1¾ in.) snout to vent, but average is about 42 mm. in adults. The tail is about 1½ to 1⅔ times the head-body length.

Color. Light gray to gray-brown above, the head lighter than body: a series of indistinct, transverse bands of darker color edged with blue on the back; head with numerous very fine, brown lines, forelegs distinctly barred, hind legs without distinct evidence of a barred pattern; belly light; chin and sides of gular region mottled; middle of throat bluish in adult males; chest and preanal regions mottled, dark, in adults. Sides of belly bright blue in adult males.

Scalation. Dorsal scales highly irregular in size; on either side of mid-dorsal line a row of enlarged, keeled scales beginning on the shoulders a little posterior to the level of insertion of the forelegs, and continuing upon the tail; separating these from each other is 1 or 2 rows of small, keeled or smooth scales, and bordering them laterally is another broken series of scales less than half as large as the inner row of enlarged dorsals; scales on sides very small; a distinct dorsolateral fold studded by clusters of enlarged scales becoming larger posteriorly, but terminating anteriorly in a pair of larger groups of scales. A feeble lateral fold. Belly scales smooth, flat, imbricated.

Head scales fairly irregular but of relatively large size, including a large, median, posterior interparietal bounded on either side by a parietal and a frontoparietal; a divided frontal; 4 or 5 enlarged supraoculars; a pair of prefrontals and 3 frontonasals; a single rostral separated from nasals by a row of scales; a pair of scales between nasals; an elongate subocular; labials

with vertical sutures; a triangular mental bordered posteriorly by 2 scales between infralabials; ear opening bordered anteriorly by enlarged denticles. Postfemoral pocket regularly present. Femoral pores generally 10 to 11; males with enlarged postanal scales.

Pl. 65. *Urosaurus ornatus ornatus.* A, Helotes, Texas. B, Kendalia, Texas; males.

Recognition Characters. The irregular size of the dorsal scales—some granular, others fairly large—will separate this race from any other species of lizard that occurs within its range. To distinguish it from its western relative, the Great Bend uta, is not so simple, for they are very closely related. The chief differences between the two are in the ventral color of adults (dark interfemoral and interhumeral regions in *o. ornatus,* light in *o. schmidti*), and in the smaller size of the outer row of enlarged dorsals in *o. ornatus* as compared with the larger scales of *o. schmidti.*

Habitat. In southern Brown County these lizards were commonly observed on the trunks of small trees in the bottom of arroyos leading to the San Saba River. The race appears to be almost completely restricted to an arboreal habitat, and has been observed on rail fences.

Habits. Nothing specifically recorded.

Problems. Any observations on the life history will be a contribution.

Reference. Mittleman, 1942, pp. 133–135, pl. 1, description, range (*gen. lit.*).

Chiricahuan Tree Uta *Urosaurus ornatus chiricahuae* (Mittleman)

(Pl. 66)

Range. Chiricahua and Dos Cabezas Mountains, southeastern Arizona. Type locality—Pinery Cañon, Chiricahua Mountains, 6000 feet, Cochise County, Arizona. (Map 18, p. 496.)

Size. Much the same as in *o. linearis.* The maximum recorded is 51 mm. snout to vent (about 2 in.), the average about 48 mm.

Color. As in the lined tree uta, except that the throat is generally uniform blue, instead of yellow or orange-centered. The preanal and chest regions are a more or less uniform gray, while in *o. linearis* they are mottled or heavily stippled.

Scalation. Much as in the northern cliff uta.

Recognition Characters. From the lined tree uta, its closest relative, the Chiricahua tree uta differs in color, as stated above, in the size of the enlarged dorsal scales (larger than dorsal leg scales in *o. chiricahuae,* equal or smaller than those in *o. linearis*), and in the extent on the base of the tail of the series of enlarged dorsals (farther in *o. chiricahuae*).

Habits and Habitat. Probably much as in *o. linearis,* but not recorded.

Problems. The peculiar distribution of this race, the only endemic one known from these mountains, suggests the necessity of further study, particularly in the field.

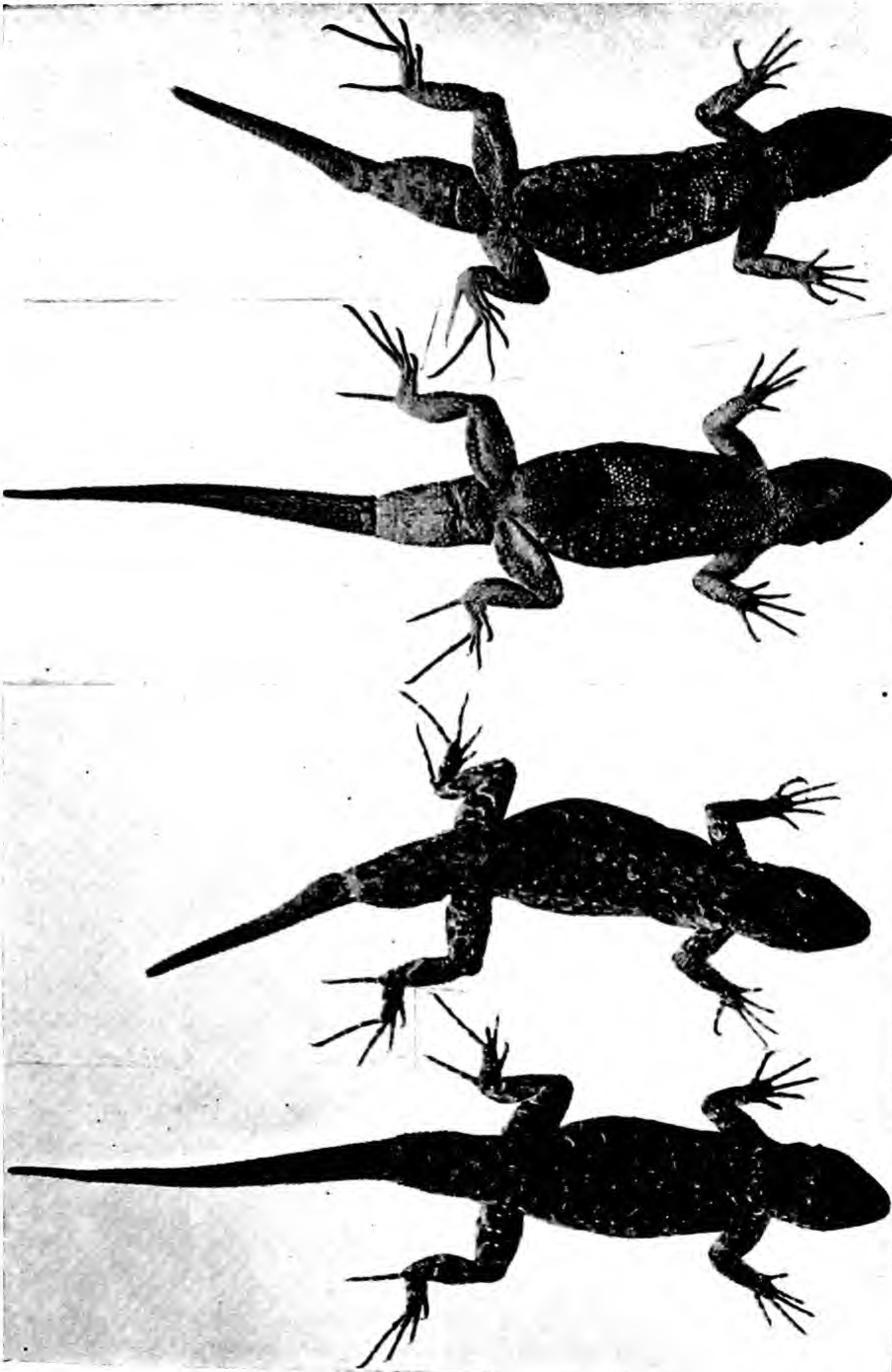
Reference. Mittleman, 1942, pp. 139–142, pl. 5, description, distribution, comparisons (*gen. lit.*).

Swift Uta *Urosaurus ornatus levis* (Stejneger)

(Fig. 79, p. 256)

Range. Northern central New Mexico, in Rio Arriba and extreme northern Sandoval counties. Type locality—Tierra Amarilla, Rio Arriba County, New Mexico. (Map 18, p. 496.)

Size. Average snout-vent measurement in adults about 43 mm. (about 1¾ in.), maximum perhaps about 50 mm. Tail about 1½ to 1⅔ times as long as the head and body.



Pl. 66. *Urosaurus ornatus chiricahuae*. Dos Cabezas Mountains, Arizona; male. U.S. Fish and Wildlife Service photographs.

Color. Much as in *o. wrighti,* except that the lateral abdominal blue areas are usually not fused medially.

Scalation. See Fig. 79. Much as in *wrighti,* except "dorsal scales of basal portion of tail very gradually merging to the lateral basal scales, without any noticeable demarcation between dorsal and lateral scales" (Mittleman).

Recognition Characters. Of all the forms that occur in the same area, the variable size of the dorsal scales is unique in this race. Comparisons with other forms of the species are given in the key.

Habitat. Unknown specifically. The elevation at the type locality is 7800 feet.

Habits. Not recorded.

References. Mittleman, 1942, pp. 147–148, pl. 6, description, range (*gen. lit.*); Stejneger, 1890, p. 108, description (*lit. cit.*).

Lined Uta *Urosaurus ornatus linearis* (Baird)

(Fig. 81, p. 257; Pl. 67)

Range. Western New Mexico and Arizona except the northern and extreme western portions, southward a short distance into Mexico. Type locality—Nogales, Sonora, Mexico. (Map 18, p. 496.)

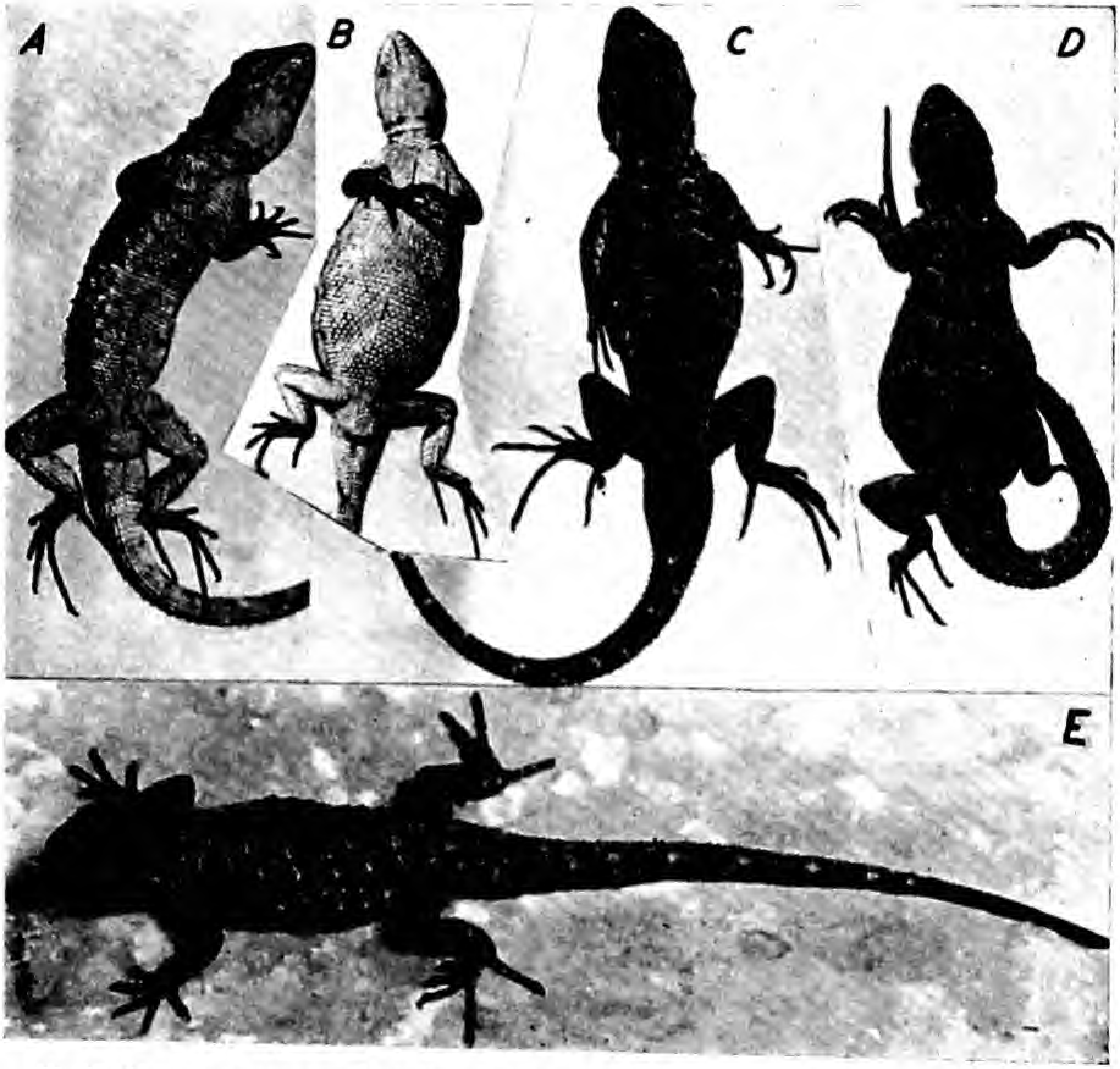
Size. Maximum snout-vent length about 56 mm. ($2\frac{3}{16}$ in.), average in adults about 46 mm. The tail $1\frac{1}{2}$ to $1\frac{3}{4}$ times as long as the head and body.

Color. Light to dark gray above, sometimes with a bluish tinge. About 6 to 8 darker crossbands on back, twice as broad as interspaces, all broadly interrupted medially and the two halves sometimes staggered, the median ends frequently somewhat flared. The edges, especially the posterior, are usually white or blue. The bands may be very indistinct or well defined. There may be a dusky dark line extending along the sides from the eye to the rump. The limbs are barred with a similar color, but the bars on the hind legs are usually very dim, those on the forelegs being more prominent and regular in occurrence. The head is usually marked with an intricate pattern of fine, dark lines. The tail has numerous dark crossbands separated by much narrower light spaces. These are sometimes visible on the ventral surfaces, although dimmer.

In females the ventral surfaces are white, with black dots and flecks scattered on the anterior and lateral gular region. Usually elongate dark streaks are present on the sides of the abdomen, and sometimes on the chest, the subcaudal surface, and the ventral surface of the hind legs; those on the sides of the belly are the most prominent. In life the ground color of the throat may be uniform white, or orange to yellow. In preserved specimens the orange or yellow fades to white or cream.

In males the sides of the belly, from the level of the axilla nearly to the groin, are pale blue; these blue patches may meet medially, so the entire

belly is blue, or there may be a narrow median line between them. The throat, except near the lips and laterally, is pale, greenish blue, or yellow to orange; in some localities blue throats are the predominant type, whereas in others yellowish throats are more frequent; whether the ratio between the frequencies of occurrence of these color types has any geographical



Pl. 67. *Urosaurus ornatus linearis.* A, C, Sonoita, Arizona; male. B, Carr Canyon Reservoir, Huachuca Mountains, Arizona; female. D, Peña Blanca Springs, Arizona; female. E, Pinos Altos, New Mexico. Gloyd photograph.

correlation is not known. The sides of the throat, lips, chest, and the ventral surfaces of the limbs are suffused with gray to a varying degree, and in addition are usually streaked or mottled with black. Some black mottling occurs in the blue areas also. The preanal region and ventral surface of the hind legs may be bluish.

Scalation. Much as in the Texan tree uta, except that the enlarged dorsals are in 2 regular, nearly continuous rows on either side of the small median

scales and begin just in front of the insertions of the forelegs instead of posterior to them; the scales in the outer row of enlarged dorsals are nearly as large as those of the inner row, instead of half as large or less; the tubercles on the sides of the body are so arranged as to give an effect of a series of diagonal lines; the median rows of small scales may be greatly reduced, so that only one row, sometimes incomplete, may separate the paravertebral, enlarged dorsals.

Recognition Characters. From other lizards occurring within the range of the lined uta, the latter may be distinguished by the irregular size of the dorsal scales—some granular, some enlarged. Comparisons with related forms of the same species are given in the key to species of the genus.

Habitat. Various authors have recorded specimens from almost every conceivable desert habitat with the exception of the ground. These are definitely not terrestrial lizards, although of course they must descend to the ground in order to go from one tree or bush to another, or from one boulder to another. In general it appears that they are most abundant on rocks, but also frequently inhabit trees and bushes. They may wander to any other elevated object, such as buildings, cacti (cholla), etc. Ruthven's tentative conclusion seems to be borne out that it "is primarily a plateau form which is able to extend its range from the major habitat (Piñon-Cedar association) down the cañons, and into the Willow-Poplar association along the streams of the plains." Out on the desert proper, toward the west, this race is replaced by two others: *o. symmetricus,* a purely rock-dwelling race, and *graciosus,* a purely tree-dwelling species.

Habits. These utas are noted for their activity and alertness. When being hunted they are exceedingly clever in keeping on the opposite side of the tree limb or boulder. Seen to disappear at some particular level of a tree or boulder, they can be expected not to be just around on the other side at that same level, but at some other level. If being followed closely they climb rapidly, always keeping to the opposite side and peeking frequently to assure themselves of the position of the intruder. When not moving they are exceedingly difficult to distinguish. One can inspect a likely looking tree thoroughly, then sit down quietly at its base, and in a few moments become aware, by their movements, of specimens whose presence was previously entirely unsuspected.

Regardless of the immediate habitat, the color of the lizards tends very strongly to resemble that of the background. This adds greatly to the difficulty of distinguishing them. Very frequently they are associated in pairs; in fact the general rule may be accepted that where one is found at least one other should be present.

On boulders the lizards tend to be more wary than on trees. The difficulty of concealment and escape on the boulders probably is partly responsible for the greater caution shown by those inhabiting rocks. When excited

they very frequently pump the body up and down agitatedly by extending and flexing the limbs. Several authors have observed that all four legs are involved in these gymnastics. Some other species of the utas regularly use only the forelegs, as does *Sceloporus* and numerous other iguanids. It would be of interest to accumulate exact observations on this phenomenon in various species and races of *Urosaurus*, for there may well be a phylogenetic significance in it. In moving about they jump with alacrity and cling to vertical surfaces with as much freedom as the anoles.

As is the case with many other diurnal desert reptiles, the chief periods of activity are in the morning and late afternoon; during the hottest part of the day they are generally inactive. They may remain active in the evening until after dark.

The food consists of flies, beetles, centipedes, and other arthropods. In captivity they have been kept several months by feeding them houseflies and meal worms.

The eggs number about 9. The young hatch in early August.

Problems. The food and breeding habits of this species are largely unknown.

References. MacCoy, 1932, p. 17, habits (*Ariz.*); Mittleman, 1942, pp. 137–139, pl. 3, description, range (*gen. lit.*); Mosauer, 1932, pp. 5–7, habits, New Mexico and Texas (*N.M.*); Ortenburger, 1926, p. 106, habits (*Ariz.*); Ruthven, 1907, pp. 531–532, habitat (*Ariz.*).

Big Bend Uta *Urosaurus ornatus schmidti* (Mittleman)
(Pl. 68)

Range. The Big Bend of the Rio Grande southward from the Davis Mountains, and adjacent Mexico. Type locality—Fort Davis, Jeff Davis County, Texas. (Map 18, p. 496.)

Size. Maximum size about 52 mm. (2 in.) snout to vent; the average length in adults is about 43 mm. The tail is about 1¼ to 1⅔ times as long as the head and body.

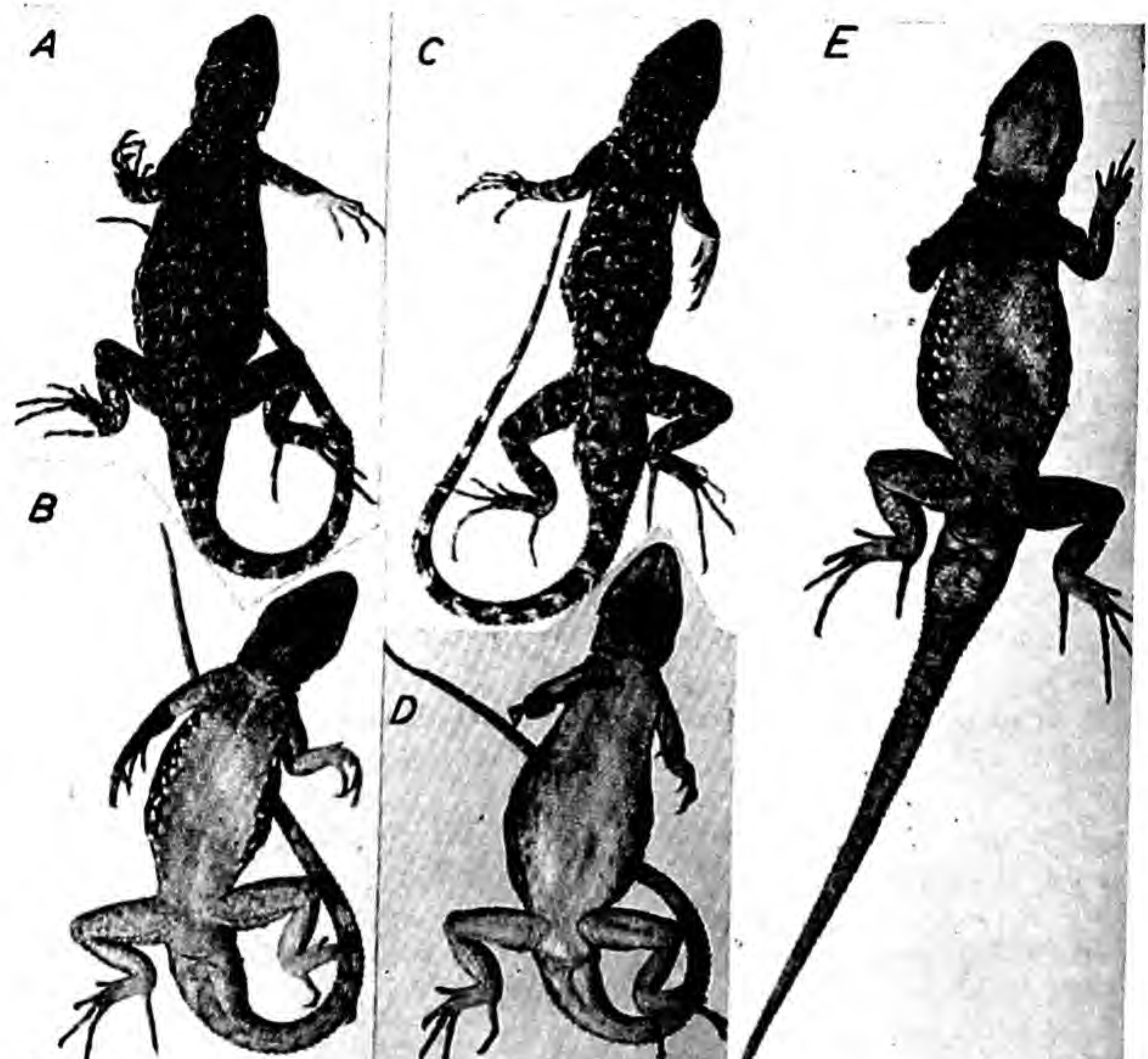
Color. As in other races of *ornatus*, but ventral surfaces more nearly uniformly light, except for the blue areas on the sides of the belly in males.

Scalation. Much as in the Texan tree uta except for "enlarged dorsal scales arranged more regularly; the inner series of enlarged dorsal scales not twice as large as those of the outer series; largest of the dorsal scales occasionally equal to, but more often smaller than, the enlarged, keeled scales of the antero-dorsal surfaces of the tibia and femur" (Mittleman).

Recognition Characters. The irregular dorsal scales—some enlarged, some granular—will identify this lizard and separate it from all others occurring within its range. From *o. linearis* it may be distinguished by its smaller size, the irregularity of the enlarged dorsals, and the absence of an arrangement

of the lateral tubercles forming a series of diagonal lines; also the lateral belly patches are generally separate in males, rather than fused medially.

Habits and Habitat. In spite of the fact that numerous expeditions of well-known scientists have been devoted to investigations in the Big Bend area, no detailed summary of the herpetological fauna of that region has been



Pl. 68. *Urosaurus ornatus schmidti.* Fern Canyon. Alpine, Texas. A, D, female; B, C, E, male.

written, and their observations on the natural history of its reptiles have not been published. The species known from this area, with some natural history notes, have been recorded in a recent paper by Schmidt and Smith (*Tex.*). The lack of records is reflected in the scant knowledge of the natural history of this species. One author records that it is common *on rocks* (not on trees as is the case of the Texas uta), and another adds that it was not observed below 5000 feet. Any collector could add to this!

Reference. Mittleman, 1942, pp. 135–136, pl. 2, description, range (*gen. lit.*).

Pl. 69. *Urosaurus ornatus symmetricus.* Yuma, Arizona. Courtesy of J. R. Slevin.

Symmetrical Uta *Urosaurus ornatus symmetricus* (Baird)

(Figs. 52, 55, p. 91; Pl. 69)

Range. The Colorado River Desert northward to extreme southern Nevada, in California, Arizona, Baja California, and Sonora. Type locality—Fort Yuma, Imperial County, California. (Map 18, p. 496.)

Size. Maximum known snout-vent length 63 mm. (2½ in.); average length in adults about 55 mm. The tail is about 1½ to 1⅔ times as long as the head and body. This is the largest race of the species.

Color. The dorsal pattern is much as in *o. linearis*, but the ground color tends to be lighter—a very light olive gray to brownish gray—and the dark crossbands tend to be rather dim. The supralabial region is white or cream; this color continues posteriorly to the ear and is sometimes faintly discernible beyond the ear.

The ventral surfaces in both sexes are a uniform white, unmarked with black or gray. The throat in females is yellow to orange in life, and in males is blue or yellow to orange, or some combination of these colors. In preserved specimens the throat usually bleaches to white in both sexes.

In males the sides of the belly, from near the axilla to near the groin, is pale blue. The tail is uniformly white, or slightly grayish, below.

Scalation. As in the lined uta, but the paravertebral series of enlarged dorsals are separated from each other by several series of scales and a distance greater than the width of the largest dorsal scale.

Recognition Characters. The irregular dorsal scales of various sizes distinguish this lizard and the long-tailed uta from any others occurring in the same area. Comparisons of these with each other are given in the discussion of the latter.

Habitat. This race is found almost exclusively on boulders, very seldom on the ground or on trees.

Habits. Since most of the western utas have had a confused history and this particular race has not been singled out for study by many naturalists, its specific life history is not well known. In many respects it must be very similar to that of *o. linearis*.

Problems. The relationships of this race to *o. linearis* and to *graciosus* are problems that merit much study and field observation. Mittleman believes that this and *graciosus,* even though overlapping almost completely geographically, are generally well isolated ecologically and interbreed sufficiently to show intergradation of distinguishing characters. This conclusion may be correct, but such an unusual possibility deserves further study and corroboration. The scattering of *graciosus* in *o. symmetricus* populations is so complete that, if interbreeding occurs at all, it is difficult to conceive of the successful maintenance of the separate identities of the two forms. The conclusion, ordinarily, would be that either these are distinct species, which may occasionally hybridize, or they are variations of a single form. Many observations by many collectors support the distinctness of the two forms, which thus tentatively I regard as separate species. This decision does not pretend to refute Mittleman's idea that these two forms are very close, "equivalent offshoots of the same stock, and of about equal age."

Reference. Mittleman, 1942, pp. 142–143, pl. 4, description, variation, range (*gen. lit.*).

Northern Cliff Uta *Urosaurus ornatus wrighti* (Schmidt)

(Pl. 70)

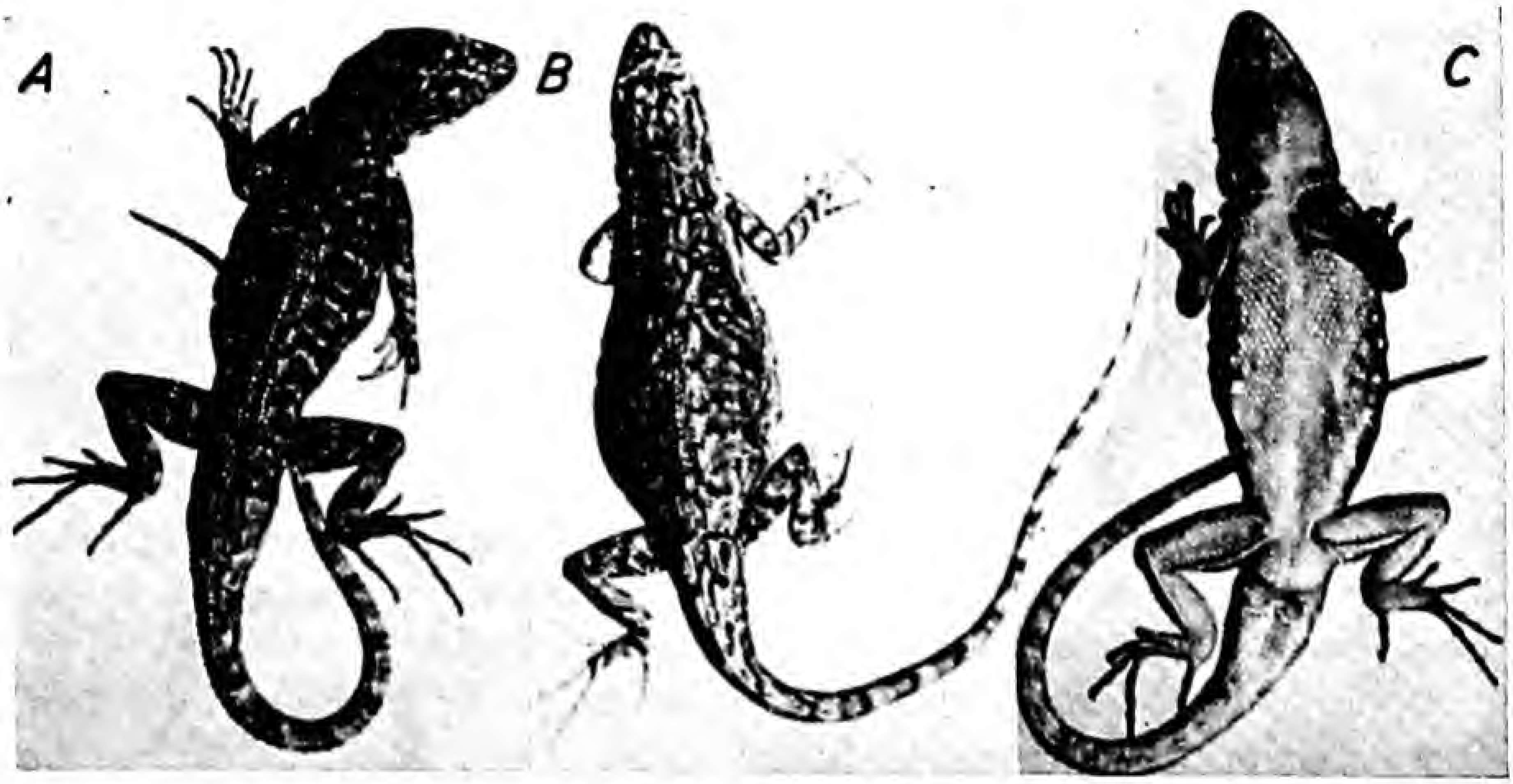
Range. Eastern and southern Utah, northern Arizona, southwestern Colorado and northwestern New Mexico. Type locality—Grand Gulch, 4000 to 5000 feet, San Juan County, Utah. (Map 18, p. 496.)

Size. Moderate, the maximum snout-vent measurement about 52 mm. ($2\frac{1}{16}$ in.). The tail is about $1\frac{1}{2}$ to $1\frac{2}{3}$ times as long as the head and body.

Color. Ground color pale gray to yellow-brown. About 6 to 8 light-edged, darker crossbands on the back, twice as broad as interspaces, frequently interrupted medially and the two halves sometimes staggered; the median ends may be somewhat flared. The limbs are barred with a similar color, more distinctly on the forelegs than on the hind legs. The tail has dim, dark bands separated by narrow light spaces; the bands are sometimes visible on the ventral surface. There is usually a narrow dark streak across the top of the head at the middle of the orbits, and numerous other fine lines forming an intricate pattern.

The ventral surfaces are white, dimly mottled. In males the sides of the belly, from the axilla to near the groin, is dark blue, sometimes with dim, lighter blue flecks; the two patches may not quite meet medially, but according to Mittleman are "usually fused medially for the greater part of their length; interhumeral and interfemoral regions pale gray, mottled or not, but usually with dark gray or blue." The throat is blue, greenish blue, orange, or yellow in males.

Scalation. Most dorsal scales small, flat; several series of enlarged, keeled scales beginning just behind the anterior margin of the insertion of the hind leg, and extending to the tail; the median 2 rows are much smaller than the 2 or 3 rows bordering them on either side; these grade either rather abruptly or very gradually into the granular lateral scales; scales on the inner row of the enlarged paravertebrals averaging but little to considerably larger than those in the outer rows. A few slightly enlarged scales scattered along a



Pl. 70. *Urosaurus ornatus wrighti.* Moab, Utah. A, C, male; B, female.

dorsolateral line on the posterior part of the body; no distinctly enlarged tubercles on sides of neck.

Head scales relatively large, flat, but numerous; ear opening bordered anteriorly by a few short denticles.

Femoral pores 12 to 16. Males with enlarged postanal scales; lateral scales at base of tail abruptly smaller than dorsal basal scales.

Recognition Characters. Within its range, the dorsals of irregular size will identify this race and distinguish it from all other species of lizards. Toward the southern periphery of its range it meets the lined uta, however, and intergrades with it over a more or less extensive area. Comparisons with that race are given in the key to the species of *Urosaurus.*

Habitat. Numerous authors agree that this form is highly restricted in its preference for boulders, canyon walls, and cliffs. In this respect it is widely different from *graciosus, o. ornatus,* and others, but similar to *o. symmetricus.* It is of interest that *o. linearis,* a central form geographically, is also the most ubiquitous in habitat.

Habits. As could be expected, the food consists almost entirely of arthro-

pods, and mainly of insects. Courtship and copulation have been observed on June 14. "The male twice took tail of female in his mouth, before copulation" (Eaton).

Problems. The life history and distribution of this race are problems that remain to be studied. Cole's record for Idaho (*Idaho*) seems very dubious and is probably based upon a true *Uta* instead of a *Urosaurus.*

References. Eaton, 1935, p. 10, habits, habitat (*Ariz.*); Knowlton, 1934, p. 999, food, Utah (*lit. cit.*); Mittleman, 1942, pp. 145–147, pl. 9, description, range (*gen. lit.*).

The Ground Utas

Genus *UTA* Baird and Girard

This small genus, comprising three forms of a single species in the United States and about eleven all told, is restricted to the western United States, northern Mexico, Baja California, and adjacent islands.

As the name indicates, most members of this genus are ground dwellers. Some live mainly on rocks. All are rather small, brownish, striped or

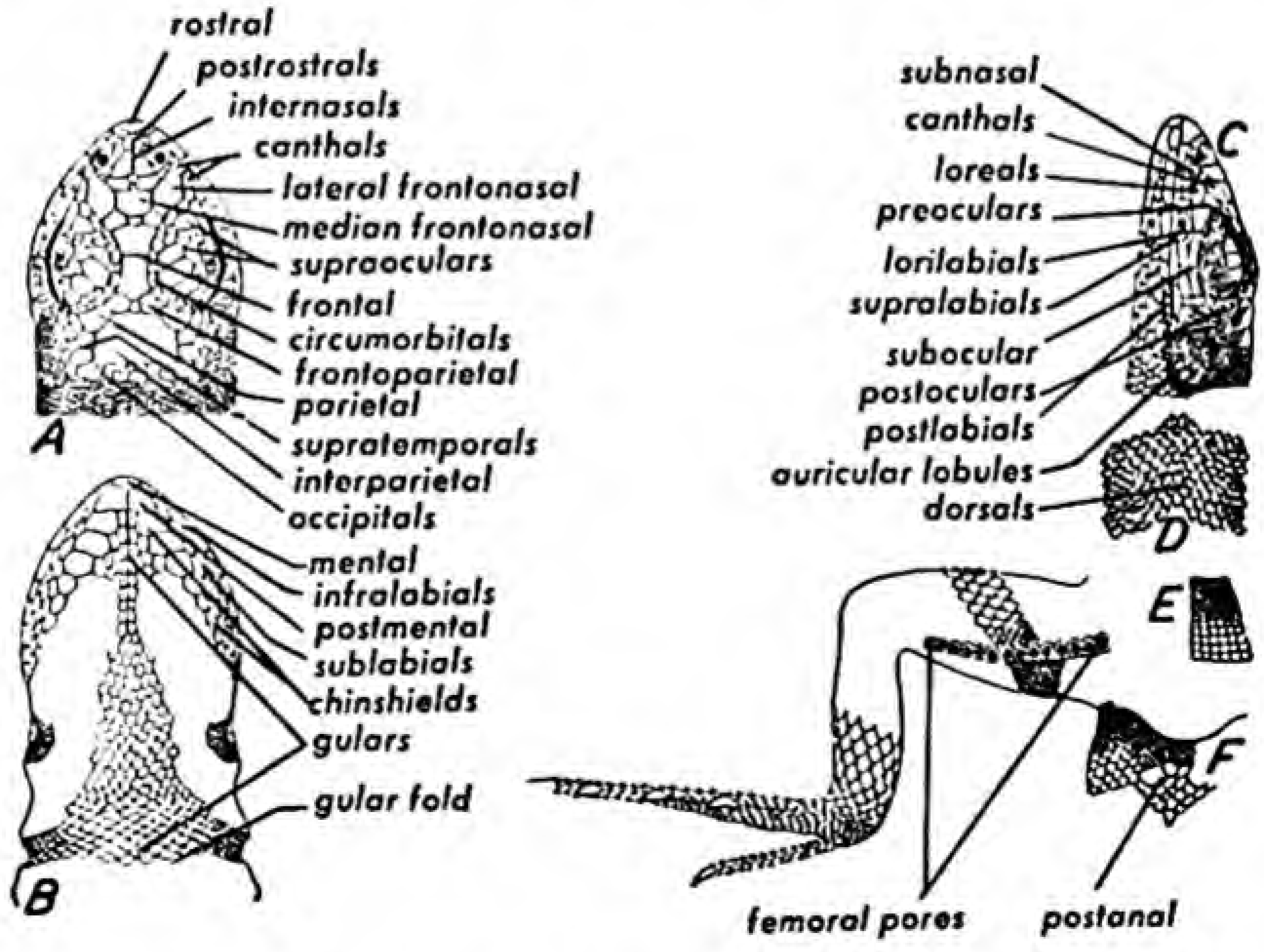


FIG. 82. Typical scutellation in *Uta,* from *U. stansburiana stejnegeri,* between Nogales and Rio Grande. A, top of head; B, underside of head; C, side of head; D, section of dorsal surface of body; E, section of side of body; F, ventral view of right hind leg and anal region. From Cope.

speckled lizards. All lay eggs and are diurnal in habit. Some details of the scutellation of a typical member of the genus are shown in Fig. 82.

KEY TO SPECIES OF *UTA*

1. Usually 2 scales between both enlarged internasals and rostral (Fig. 83) .... *stansburiana hesperis* (p. 281)
   Usually only 1 scale separating one or both internasals from rostral (Fig. 82A) 2

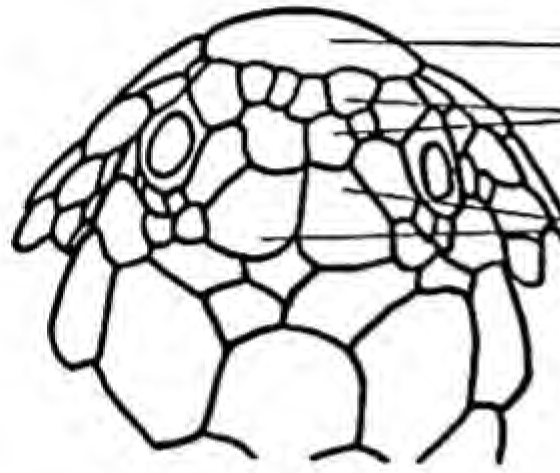


FIG. 83. *Uta stansburiana hesperis*, dorsal view of snout.

2. Dorsal scales usually 94 or more; females lacking dorsolateral light stripes with continuous dark borders; prefrontals usually not in contact on middorsal line (as in Fig. 82A) .... *stansburiana stansburiana* (p. 277)
   Dorsal scales usually 93 or less; females with distinct, dark-edged, continuous, dorsolateral light stripes; prefrontals usually in contact on middorsal line .... *stansburiana stejnegeri* (p. 283)

Northern Ground Uta *Uta stansburiana stansburiana* Baird and Girard

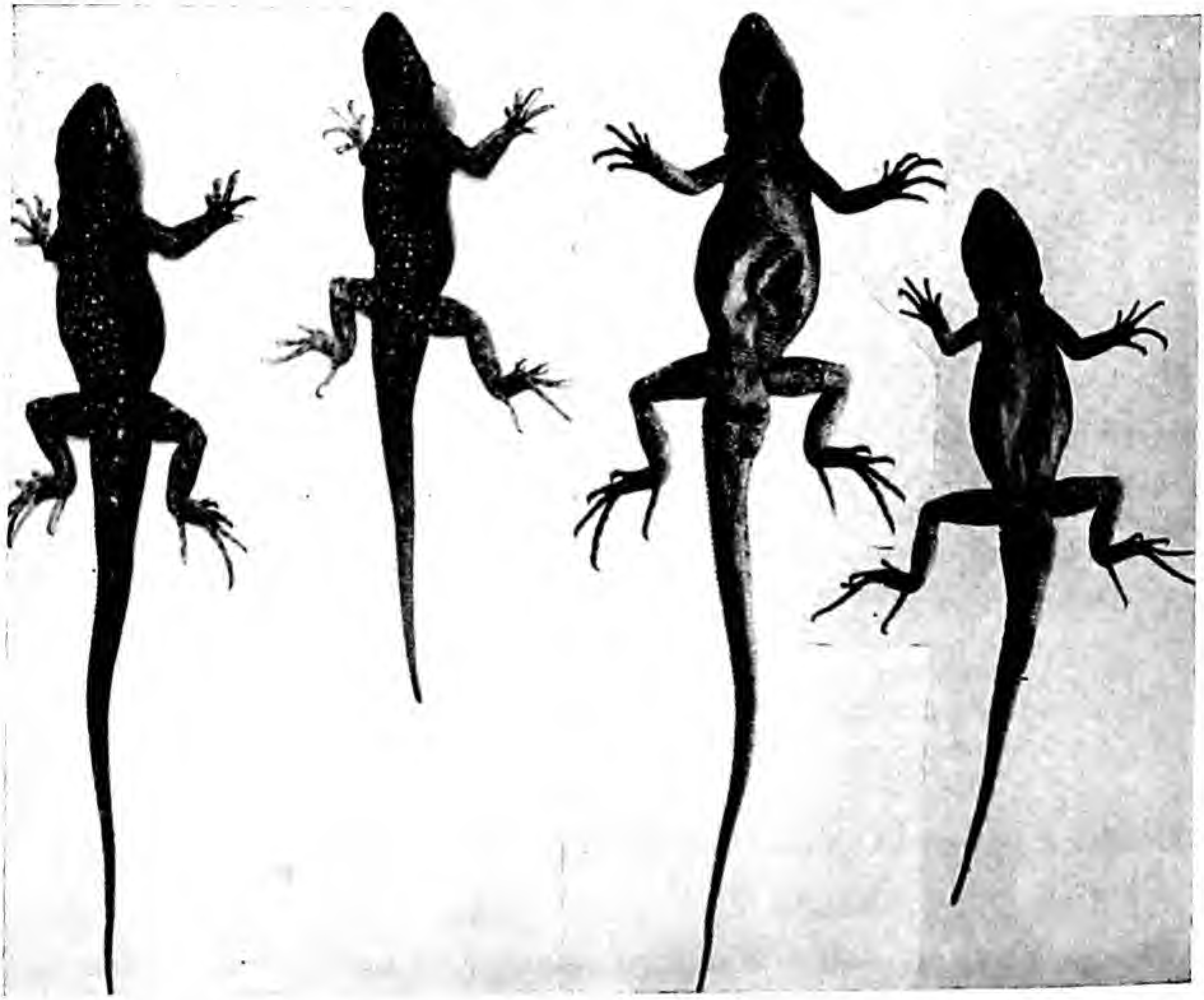
(Fig. 45, p. 89; Fig. 53, p. 91; Pl. 71)

Range. Southern central Washington southward through eastern Oregon and California as far as Death Valley, eastward through southwestern Idaho, all of Nevada except southern corner, most of Utah except northeastern and southwestern corners, southwestern Colorado, and northwestern New Mexico. Type locality—Salt Lake Valley. (Map 19, p. 496.)

Color. In this race the dorsal pattern differs but little in the two sexes. There are two types of color pattern. Toward the south the dorsolateral light stripes are distinguishable, although not bordered by continuous dark lines; and a series of fairly large, dark brown spots is present on either side of the median line. The stripes are somewhat more distinct in females, but the difference is slight. A dark patch above the arm insertion may or may not be present. In males numerous light flecks may be scattered on the back and sides. A large, black, postaxillary blotch is present in males, absent or faintly

indicated in females. Young are marked more distinctly on the dorsal surface than adults.

Another pattern occurs in part of western Utah and eastern Nevada; it is the one possessed by the types of Ruthven's *nevadensis*. In these there are practically no dark spots whatever on the back; only a few black flecks are scattered about. The light stripes are totally absent, except on the neck, where they are dim. Females are practically a uniform brown or olive above, with



Pl. 71. *Uta stansburiana stansburiana.* Columbia River Vantage, Grant County, Washington; males. U.S. Fish and Wildlife Service photographs.

only a few small black flecks and a few dim light spots, but males have numerous small light spots scattered over the back and sides. Males tend to have the entire ventral surfaces suffused with gray, less distinct posteriorly; even in females the throat and anterior part of chest may be grayish; the lips are mottled or barred.

Scalation. Similar in most respects to that shown in Fig. 82. Dorsal scales small, overlapping, distinctly but rather weakly keeled, grading into smaller, convex or subconical, lateral scales, 89 to 116 from occiput to base of tail, average 103. These in turn merge gradually with the larger, flat, belly scales.

Dorsal tail scales larger than others on the animal, strongly keeled. A distinct, granular, gular fold, overlapped by enlarged scales. Ear opening moderate, overlapped by 3 or 4 scales projecting from its anterior margin. Three or 4 enlarged supraoculars, separated from median head scales by 1 or 2 rows of small scales; a divided frontal, 2 prefrontals, and 3 frontonasals, all somewhat irregular; prefrontals usually separated medially, or at least not meeting on the midline (76 per cent of 76 counts); a pair of enlarged internasals, one or both separated from rostral by only 1 scale (93 per cent of 70 counts). Femoral pores 11 to 17, average 14. Enlarged postanals present in males.

Recognition Characters. The uniform, small, dorsal scales, the divided frontal, the distinct ear opening, and the granular gular fold will separate the utas from other similar-appearing lizards of the United States. The three races of utas, however, are not so easily distinguished from each other. Most difficult to differentiate are *s. stejnegeri* and *s. stansburiana,* each of which has 1 row of postrostrals, whereas *s. hesperis* generally has 2. In *s. stansburiana* the striped pattern so characteristic of females of *s. stejnegeri* is absent, or broken; the males of the two races, however, may appear very similar in pattern. In scalation there are average differences in two characters: in *s. stansburiana* the dorsal scales are smaller and more numerous, generally numbering 94 or more from occiput to base of tail and the prefrontals are usually (76 per cent) not in contact on the median line. Generally in *s. stejnegeri* the dorsals number less than 94, and the prefrontals are in contact medially (82 per cent).

Habitat. Like other utas, these in general are ground-living lizards. They occur from about sea level to an altitude of at least 7000 feet. Although flat desert is perhaps their preferred habitat, they are found as well on mountain slopes, canyon walls, etc. The soil where they occur is usually coarse and gravelly, and bushes are generally found in the vicinity. Brooking has noted that in Malheur County, Oregon, "these lizards are very numerous and the most widely distributed species. They were found in the sandy flats, in rough, rocky places and even up near the bare basalt cliffs." In the Maggie Basin region, Nevada, peculiarly enough, Ruthven and Gaige record the species as "closely confined to the vicinity of rocks. Occasional specimens were found on the ground, but the majority were on the large rocks along the cliffs, upon which it climbs with all the facility of *Sceloporus biseriatus.*" Nearer central Nevada in the Toyabe Mountains area, however, they are found on the ground amongst sagebrush (Linsdale), and this agrees with observations over most of the range of the race. The peculiar habitat preference of the Maggie Basin area specimens lends support to the belief that *s. nevadensis,* described from that locality, may be valid.

Various authors have noted a marked color variation correlated to some extent with different habitats. Brooking says that "those on the sandy, steep

banks of the river or in dry washes were almost grey, while those from the rough, bare, rock areas were more nearly brown. Still others from the sage-brush-covered ridges were usually dull tan, shading almost into an olive green at times."

In Utah Knowlton and Anthon noticed that the microhabitat may vary at different times of the day: "During the hot, dry months of the summer the lizards would congregate under the succulent roadside fringe of Russian thistle, *Salsola pestifer,* largely deserting the near-by shadscale areas." A study of stomach contents of specimens from the two vegetation areas "indicates that the more abundant food supply may have been an important factor in attracting the lizards to the Russian thistle strip along the roadside. The succulent, dense plants also offered more satisfactory shade conditions, apparently allowing the lizards to feed during a longer portion of the hot summer days."

Habits. In general these are not extremely wary lizards. They can be caught by hand on occasion or can readily be noosed. When disturbed they usually run into a bush, hole, or under a rock, frequently stopping for a last look at the intruder just before disappearing from sight.

The food consists largely of insects, but normally includes occasional mites, spiders, scorpions, etc. In Utah the lizards are of great economic importance in control of the beet leafhopper. "The food consisted almost entirely of insects obtainable on or near to the surface of the ground. Grasshoppers, moths, and other large, active insects are grasped in the lizard's mouth and are beaten upon the ground with a vigorous 'back and forth' motion before being swallowed. . . . Homoptera, Hymenoptera and Hemiptera were taken in greatest abundance" (Knowlton). Sometimes, in certain areas at certain times of the year, the predominant food is quite different from that at other times, or from that of specimens taken in other areas. Beet leafhoppers sometimes predominate, at other times ants, at other times Lepidoptera larvae. The food is digested rapidly; "approximately 78 per cent of the nymphal leafhoppers were digested beyond recognition in six hours and 98 per cent digested within 12 hours, none being recognizable in lizards taken during late afternoon" (Knowlton).

On one occasion a specimen was recorded with a young example of the same species in its stomach. It must be a rare occurrence for utas to eat other vertebrates. The reverse is not uncommon, however. Birds no doubt eat them in considerable numbers; sparrow hawks and the Nevada shrike are known to do so. Numerous snakes, *Lampropeltis zonata, Hypsiglena o. ochrorhynchus* and *Thamnophis ordinoides vagrans,* prey upon them; and other lizards, as *Gambelia wislizenii,* certainly eat utas when they can get them.

The eggs are laid in early July and probably late June, and hatch between late July and the middle of August. The eggs number 3 or 4.

Problems. One of the most interesting problems concerning this race is the status of the almost uniformly colored specimens from Nevada and western Utah (*s. nevadensis*). It appears very probable that they represent a distinct race; both color and habits appear quite different from those of other specimens. Another problem, of course, is the exact area of intergradation of *s. stejnegeri* and *s. stansburiana*. The range of the race in Arizona and New Mexico is of special interest. Cary (*Wyo.*) says it occurs in Wyoming, but I find no specific records. This small group of very common lizards is replete with interesting taxonomic problems that would repay intensive study.

References. Brooking, 1934, p. 94 (*Ore.*); Camp, 1916, p. 69, taxonomy (*Calif.*); Ellis and Henderson, 1913, p. 65, Colorado range (*Colo.*); Gordon, 1939, pp. 66–67, Oregon range (*Ore.*); Grinnell and Camp, 1917, pp. 154–155, California range (*Calif.*); Knowlton, 1934, pp. 999–1000, food summary (*lit. cit.*); Knowlton and Anthon, 1935, p. 183 (*lit. cit.*); Linsdale, 1938, pp. 26–27, habits (*Nev.*); *idem*, 1940, pp. 223–224, fig. 12, Nevada range (*Nev.*); Richardson, 1915, pp. 412–413, taxonomy (*Nev.*); Ruthven, 1915, pp. 27–29, fig. 1, description, *nevadensis* (*Nev.*); Ruthven and Gaige, 1915, pp. 18–19, habits (*Nev.*); Ruthven and Stuart, 1932, pp. 1, 2, hatching period (*lit. cit.*); Slater, 1941, p. 91, Idaho range (*Idaho*); Stuart, 1932, p. 29, habits (*Utah*); Van Denburgh, 1922, pp. 227–233, description, range (*gen. lit.*); Woodbury, 1931, pp. 35–37, fig. 12, Utah range (*Utah*); Woodbury, 1932, pp. 15–16, food analyzed (*Utah*).

Western Ground Uta *Uta stansburiana hesperis* Richardson

(Fig. 83, p. 277; Pl. 72)

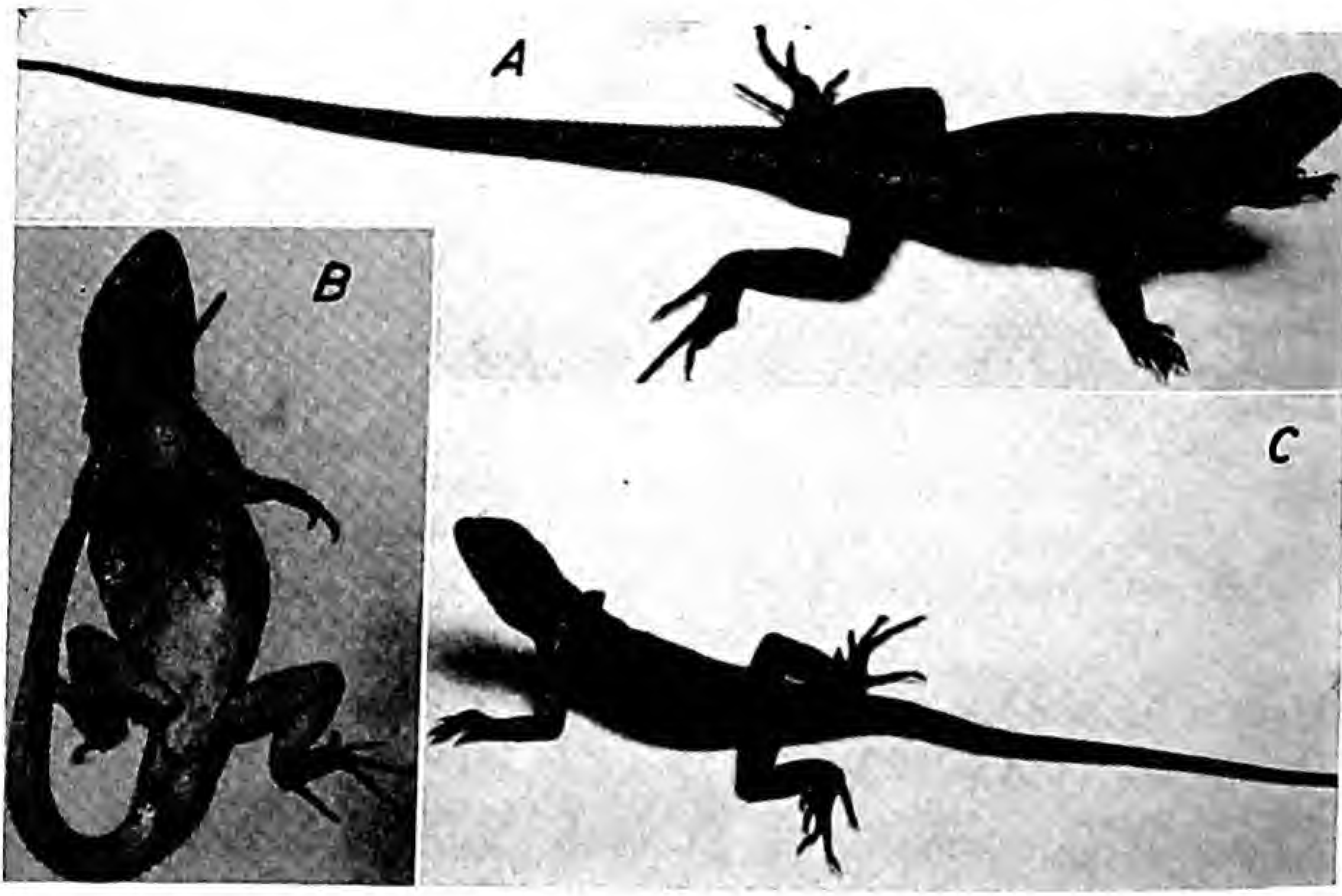
Range. The San Joaquin Valley of central California, southward to the coast in Los Angeles county, thence southward on Pacific slopes into Baja California. Type locality—Arroyo Seco Cañon, near Pasadena, Los Angeles County, California. (Map 19, p. 496.)

Color. The sexes are not so differently marked from each other in this race as in *s. stejnegeri*. The dorsolateral light stripes are usually broken by narrow, undulating crossbands about 10 in number, each light-bordered behind and blending with the ground color anteriorly. If the stripes are not broken by the blotches, then they at least lack continuous dark borders. While these undulating bars are most prominent in females, extending from near the middorsal line onto the sides of the body, they are evident in all males, even the largest, at least near the shoulders. Below the position of the dorsolateral light lines, just above the arm, is a very dark brown or black blotch, bordered on either side by a white line; there may be a similar mark just above the dorsolateral light line. The sides of the body are usually light-spotted, but not usually marked with vertical light lines. The dorsal surface in males has small blue spots. The throat is suffused with blue centrally and

mottled or barred laterally in both sexes. The postaxillary black spot is blue in males.
prominent. The ventral surfaces of the belly are usually not suffused with

Scalation. Much as in *s. stansburiana* and *s. stejnegeri* (Fig. 82) except that almost always (57 of 64 specimens) both enlarged internasals are separated from the rostral by 2 or more scales (Fig. 83).

Recognition Characters. See discussion of *s. stansburiana.* The two rows of postrostrals is the most distinctive character of *s. hesperis.* In pattern it



Pl. 72. *Uta stansburiana hesperis.* A, male, C, female, Cucamonga Canyon, Ontario, California; U.S. Fish and Wildlife Service photographs. B, Rose Hill Station, California; female.

resembles the southern spotted *s. stansburiana;* it typically lacks the stripes of *s. stejnegeri,* and the uniform pattern of northern *s. stansburiana.*

Habitat. The habits and habitat are much like those of the northern ground uta. Klauber remarks that the western and striped ground utas belong to "probably the most widespread of all our southwestern species, since it is found from the Lower Sonoran to the Transition Zone. No other form has so extreme an ecological range. . . . Every where it is common, amid trees, chaparral, grass, in rocky or sandy deserts; and usually, but not always, it is the commonest lizard in each of these habitats."

In the El Segundo, California, sand dune area Von Bloeker says they are "found chiefly in the vicinity of rocks, bushes, or old boards where cover can be rapidly reached whenever danger threatens."

Habits. The western utas are said not to be very wary or speedy. Normally when alarmed they take refuge in mammal burrows, but "sometimes they have little burrows, with crescent-shaped mouths, which are probably dug by themselves; for if kept in a box with enough sand in it they very soon dig down out of sight, using their front feet and working the head from side to side" (Grinnell and Grinnell). Klauber has found them under loose cap flakes on granite boulders.

Most of the year finds these lizards active, but during the winter they become dormant. On warm days even during winter they may emerge, however.

The food probably consists of much the same variety as for other utas. Wood figures that some 9000 insects are eaten a year, and that consumption reaches its peak in August, its minimum in November, December, and January. In captivity they feed readily upon flies and meal worms. They drink and eat readily "during the warm hours of the day, when they are most active."

The enemies of the western uta include various species of snakes and birds, and to a lesser extent white-footed mice and wood rats.

Wood believes the area of activity of a single specimen may be rather small, a supposition which is known to be true for many other lizards of similar habits.

A tail broken on December 20 was replaced by a new one which measured 23 mm. on May 14, 145 days (Wood).

Nothing has been recorded about the breeding habits of this race. Presumably they are much as in the northern ground uta.

Problems. This race, which seems rather well differentiated from the others of the species, has perhaps a better known geographic range than the others, yet the details of its distribution remain a problem.

References. Camp, 1916, pp. 69–70, taxonomy (*Calif.*); Grinnell and Camp, 1917, p. 156, California range (*Calif.*); Grinnell and Grinnell, 1907, pp. 12, 19–22, fig. 2, habits (*Calif.*); Klauber, 1939, pp. 72, 89, 97, habits (*Ariz.*); Knowlton, Fronk and Maddock, 1942, p. 942, food (*lit. cit.*); Richardson, 1915, pp. 415–418, taxonomy (*Nev.*); Van Denburgh, 1922, pp. 233–239, description, range (*gen. lit.*); Von Bloeker, 1942, p. 33, habitat, enemies, food (*Calif.*); Wood, 1933, pp. 122–124, food, habits, etc. (*lit. cit.*).

Striped Ground Uta *Uta stansburiana stejnegeri* Schmidt
(Fig. 82, p. 276; Pl. 73)

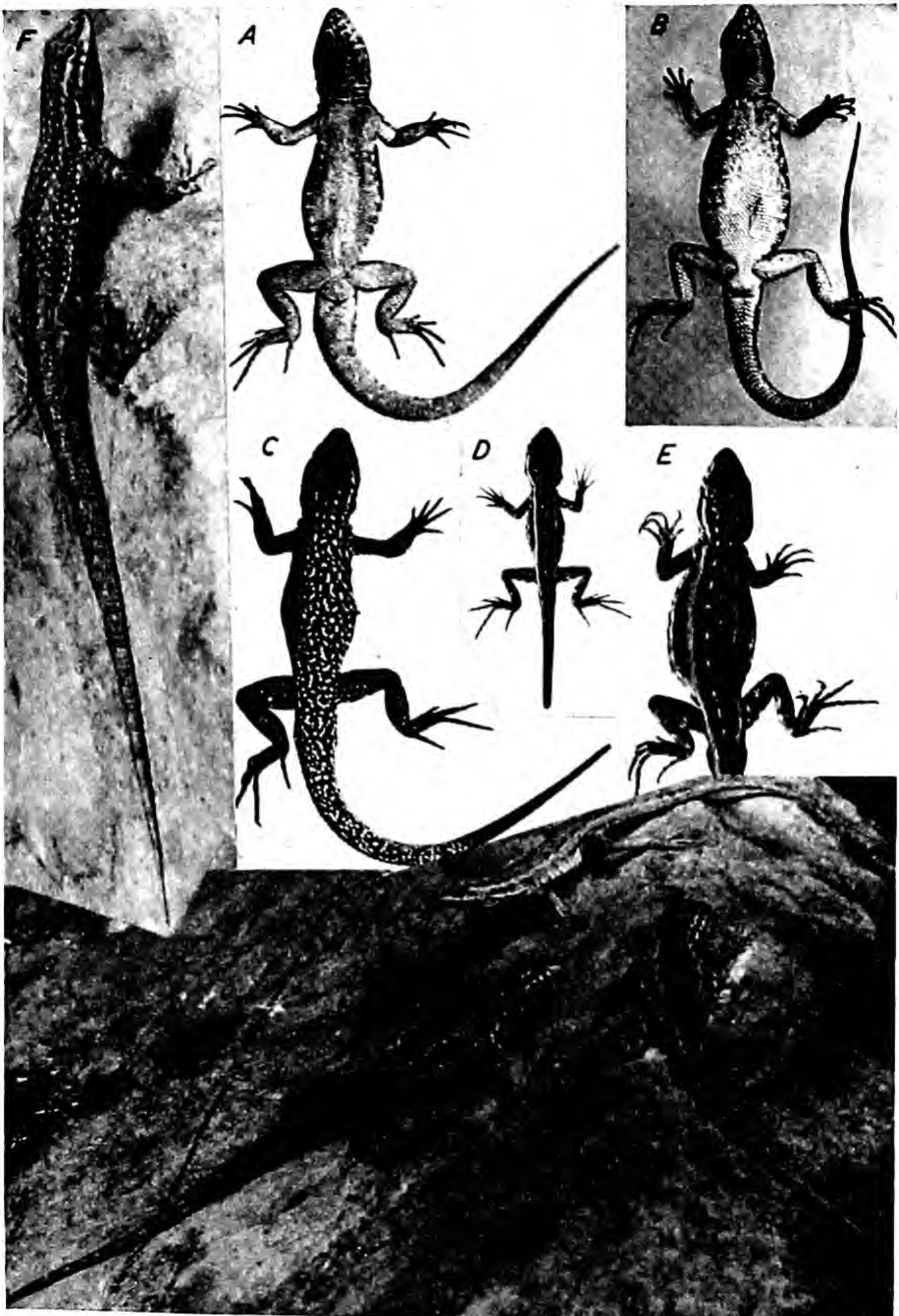
Range. Southern Nevada and eastern California east through southwestern Utah, most of Arizona and New Mexico, and western Texas, south through northern Mexico. Type locality—mouth of Dry Cañon, near Alamogordo, Otero County, New Mexico. (Map 19, p. 496.)

Color. A strongly sexual dimorphic pattern occurs. In the females a well-defined, continuous, black-edged, white or light stripe extends from the posterior corner of the eye onto the tail. Between the stripes is a brownish area, sometimes with an irregular double row of small bluish or light flecks medially; the sides of the dark area are darker, and in very young specimens may show a series of about 9 dark spots; these dark spots are not evident in subadult or adult females, or appear only as scallops on the inner edges of the dark borders of the light stripes. A nearly or quite continuous lateral light stripe, about as wide as the dorsolateral ones, extends from the posterior labial region above the arm to the groin; the dorsolateral and lateral stripes enclose between them a brown area in which, in very young specimens, a series of dark blotches may be discerned; in all except the very young these spots are invisible. Below the lateral light stripe is a dark area extending onto the edges of the belly, broken into sections by several irregular, transverse, light lines; one of these light lines, immediately behind the axilla, is very prominent, nearly pure white, and behind it is a small black or very dark blue patch. The gular region, about to the pregular fold, is mottled or reticulated with blue, or it may be blue with white specks. The shoulders and parts of the chest may be mottled. The lips are barred.

Males are easily distinguished from females by the complete absence of a lateral light stripe, except in the very young, in which it is discontinuous instead of continuous as in females. The dorsolateral stripes are present in the young, although usually not so well defined and without continuous borders as in females, but these are completely lost except on neck in fully adult specimens. The dorsal dark blotches may be present in the young, but are lost in subadults and adults. Adults have small blue flecks scattered over the dorsal surfaces, and vertical yellow bars on the sides, extending dorsally to the position of the lateral stripe. The black axillary patch is more vivid than in females, and the throat and lips are more prominently marked; the throat laterally is usually barred with dark blue, or gray, and light orange, and medially is a uniform blue. The area between the primary and secondary gular folds may be suffused with black. The belly and ventral surfaces of limbs and tail may be distinctly bluish.

Scalation. See Fig. 82. As in *s. stansburiana,* except that the dorsal scales are larger, varying from 78 to 103, and averaging about 86. There is generally but 1 row of scales between the rostral and enlarged internasals (36 in 42 counts), and generally the prefrontals are in contact on the median line (33 in 40 counts).

Recognition Characters. See discussion of *s. stansburiana.* From *s. hesperis* this race is easily distinguishable, having 1 row of postrostrals and smaller scales, but the relationship with *s. stansburiana* is close, and distinction is relatively difficult. Females of the two can be distinguished in pattern (*s. stejnegeri* with continuous, dark-edged, light stripes). In scalation the larger



Pl. 73. *Uta stansburiana stejnegeri.* A, C, male; B, female, El Paso, Texas. D, San Vicente, Texas; young. E, same locality, female. F, G, Arizona. Gloyd photographs

dorsal scales and the prefrontals in contact medially characterize *s. stejnegeri.*

Habitat. These are ubiquitous lizards occurring on fine or coarse and gravelly desert soil, or on boulders. Some authors report that they are almost exclusively saxicolous, but others maintain that they are mainly ground-dwelling. Choice of habitat is very wide; regions in which only boulders or only flat desert floors are available are equally suitable; but in areas in which both habitats are available, these lizards show a decided preference for the rocks. Vegetation may be very sparse in the bouldered areas inhabitated, but on the flat ground vegetation must be relatively abundant. This is a reflection of the necessity of having some sort of cover near at hand, for these lizards are not particularly rapid of movement nor especially alert to danger; in the bouldered zones they can find ready cover by retreating to the opposite side of a boulder, into a crack, or under a stone; but on the flats they must seek cover under bushes or, ultimately, in mammal burrows—and the abundance of these are directly correlated with the amount of vegetation in the desert. Thus humidity and availability of cover seem the chief governing factors of their choice of habitat.

Habits. The males are more wary than the females and are less frequently collected than the other sex. When disturbed they run into a bush or into the mouth of a mammal burrow, where very frequently they turn about and peek cautiously to observe the course of events. This curiosity is often their undoing.

The food, as for other utas, consists largely of insects.

Problems. The range and area of intergradation of this form with the northern uta will remain a problem until a student with more patience and thoroughness than others who have dealt with it combs the enormous collections already available for the proper solution. It is a beautiful problem, for the material—though probably lacking in some respects—is extensive; but if thoroughly done it will be an enormous task. To solve it properly will mean a study of the entire genus.

In spite of the commonness of this race, extraordinarily little is known of its natural history. This seems more generally the case for middle and eastern United States species than for the extreme western species.

References. MacCoy, 1932, p. 17–18, habits, habitat (*Ariz.*); Ortenburger, 1926, p. 107, habitat, Arizona (*Ariz.*); Ruthven, 1907, pp. 526–530, color, habitat, food, Arizona and New Mexico (*Ariz.*); Van Denburgh, 1922, pp. 240–247, pl. 18, description, range (*gen. lit.*).

The Horned-Lizard Section

The Horned Lizards

Genus *PHRYNOSOMA* Wiegmann

The most bizarre North American iguanid group is this, an entirely unique assemblage of flat, large-bodied, short-tailed, and grotesquely horned lizards. Only because we are more or less used to them do they seem somewhat commonplace. But they are truly oddities, for there are no other lizards at all like them in the world except for a curious species found—as usual—in Australia, where lives a host of zoological exceptions that makes naturalists hesitate to generalize.

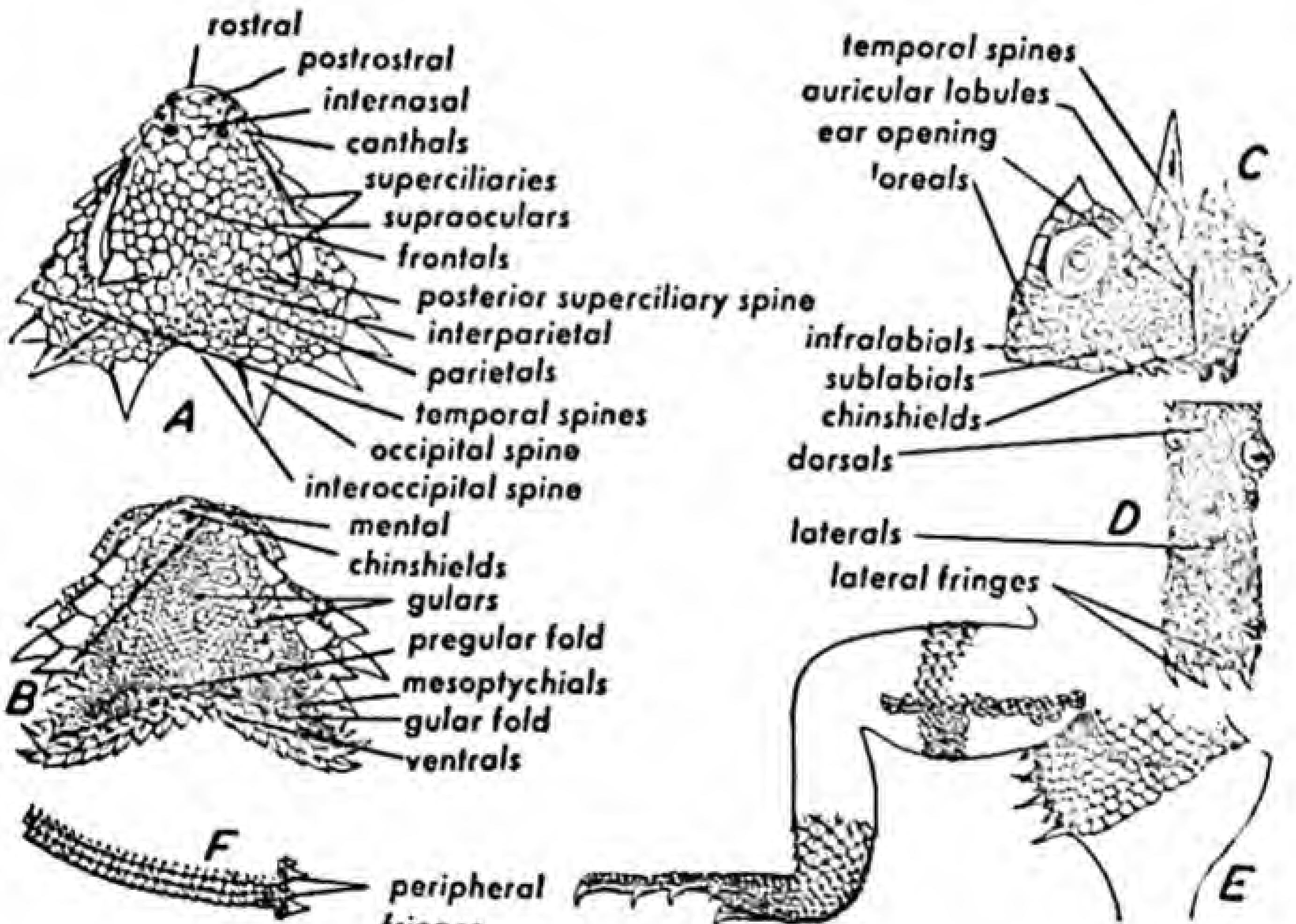


FIG. 84. Typical scutellation in *Phrynosoma*, from *P. cornutum*, west Texas. A, top of head; B, underside of head; C, side of head; D, section of side of body; E, ventral view of right hind leg and anal region; F, section of the left side of belly in ventral view. From Cope.

Some species of *Phrynosoma*, the only recognized genus of the section, lack horns, but most have some evidence of them. The most hornless of the horned toads is the exceedingly rare *Phrynosoma ditmarsi* of northern Sonora. Others are almost as denuded as this, but none so ludicrous in appearance. Some details of the scutellation of a typical species are shown in Fig. 84.

Some twenty-seven forms are recognized in the section. Most are egg-laying species, but some give birth to their young. In some species the eggs hatch in but a few hours, but in others several weeks—as in most species of lizards—are required.

The final touch of the unusual in this genus is the peculiar ability of some species to squirt blood, to a distance of several feet, from the eyes, which become swollen with blood when the phenomenon occurs, recovering normality shortly after. This phenomenon is discussed in more detail in the following pages. A highly complicated system for increasing blood pressure in the head (common to all reptiles), combined with a very thin-walled nictitating membrane (peculiar to *Phrynosoma*) makes the phenomenon possible (see introduction, p. 7). Occasional specimens of other genera (e.g., *Sceloporus*) also eject blood from the eyes on rare occasions, presumably because of some defect or injury in the membranes about the orbit.

Bryant (*Calif.*) has shown good reason to believe that the species *m'callii* should be separated from *Phrynosoma*, into a special genus *Anota*, because of the absence in it of a supratemporal fossa. The only reason this is not followed here—and perhaps why other authors since 1911 have not used *Anota* for *m'callii*—is that Bryant's work was based on a single skeleton. An interesting problem presents itself here, for should an examination of several skeletons of *m'callii* prove the invariability of the character, it should be accepted as a generic character, and *Anota* should be recognized.

KEY TO SPECIES OF *PHRYNOSOMA*

1. Two large occipital horns on either side in a continuous series with the temporals, creating a crownlike appearance (Fig. 85) . . . *solare* (p. 316)
   One occipital horn on either side, or all horns short or absent 2

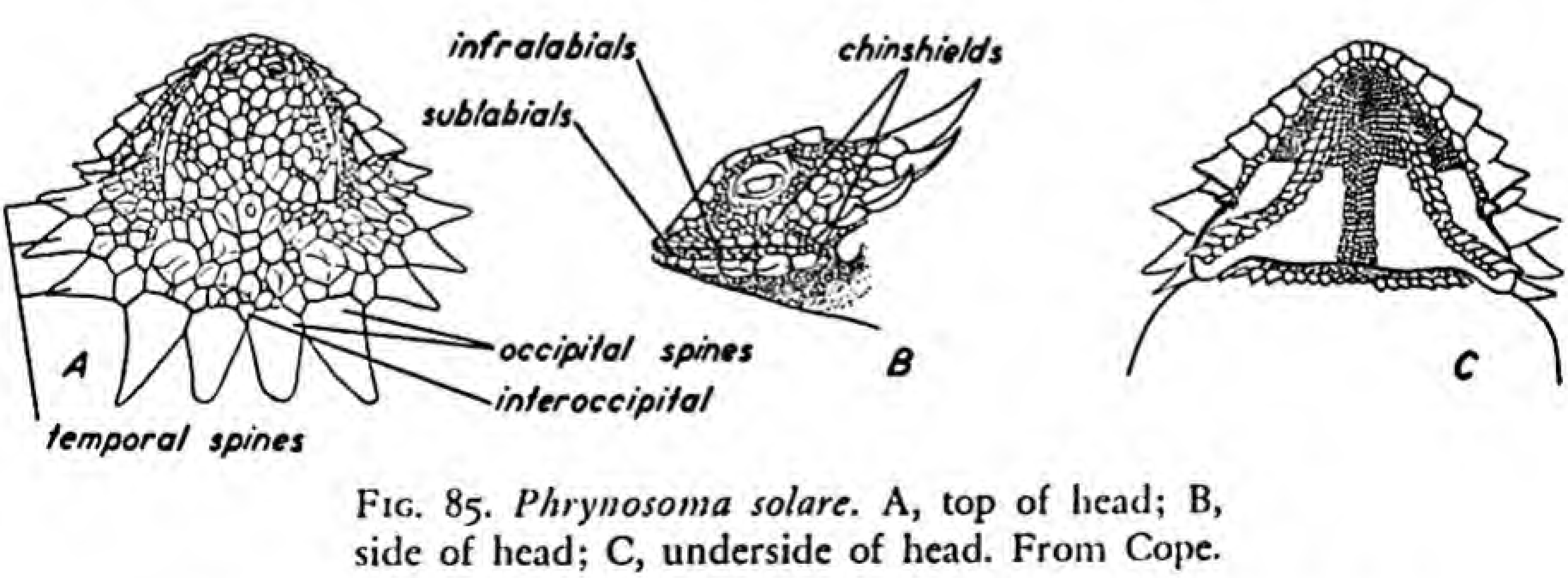


FIG. 85. *Phrynosoma solare.* A, top of head; B, side of head; C, underside of head. From Cope.

2. Several (more than 2) longitudinal series of enlarged scales on each side of throat, between the 2 series of large chinshields (Fig. 86) . 3
   Two, 1, or no longitudinal series of enlarged scales on each side of throat between chinshields 4

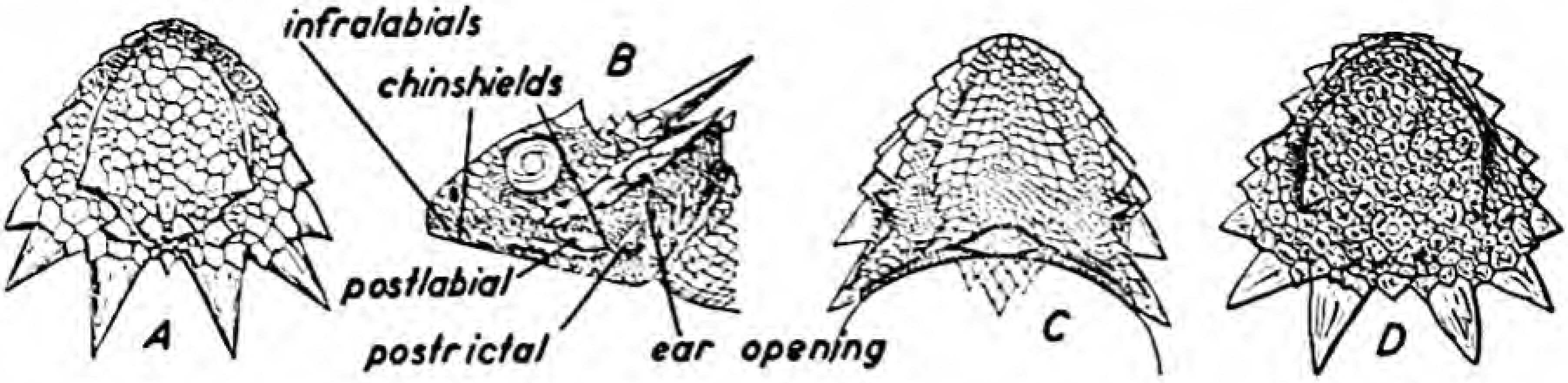


FIG. 86. A–C, *Phrynosoma coronatum blainvillii*, San Bernardino, California. From Cope. D, *P. c. frontale*, Cuyama Valley, California. From Burt.

3. Scales in frontal region markedly enlarged, nearly or quite smooth (Fig. 86A) .... *coronatum frontale* (p. 295)
   Scales in frontal region about equal in size to other head scales, rugose or rough (Fig. 86D) .... *coronatum blainvillii* (p. 293)
4. No fringe of enlarged scales at sides of abdomen; chinshields in contact with infralabials throughout (Fig. 89); tympanum concealed .... *modestum* (p. 311)
   At least 1 fringe of enlarged scales at sides of abdomen; chinshields separated from infralabials by at least 1 row of scales throughout most of the length of the series; tympanum naked or not 5
5. Rows of scales between sublabials and infralabials very numerous, 7 or 8; horns scarcely discernible .... *ditmarsi* (p. 297)
   Rows of scales between sublabials not over 4 (Fig. 87); horns sometimes short, but discernible 6

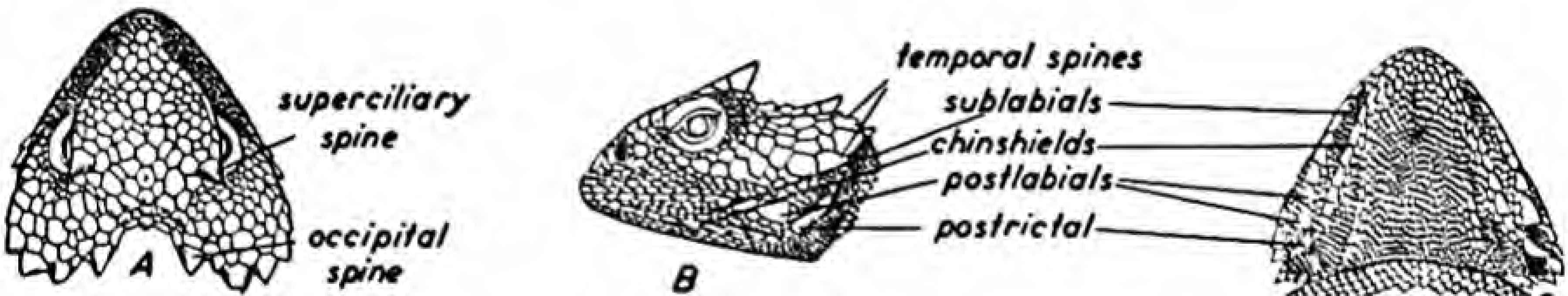


FIG. 87. *Phrynosoma douglassi hernandesi*. A, top of head; B, side of head; C, underside of head. From Cope.

6. Posterior chinshields much larger than infralabials (Fig. 84C) 7
   Chinshields smaller than posterior infralabials or the scales continuous with them posteriorly (postlabials), actually decreasing slightly in size posteriorly (Fig. 87) .... 9[6]
7. A vertebral dark streak; ventral surface white, unspotted; horns exceedingly long; tail broad, flattened; 2 fringes of scales at sides of abdomen; ear concealed (Fig. 88) .... *m'callii* (p. 308)

[6] Specimens running down to this point belong to the species *douglassii*, the subspecies of which have been very poorly studied and defined. At present they are best identified as to subspecies by locality (see Map 21, p. 498).

No vertebral dark streak; ventral surfaces usually spotted; horns shorter; tail not so broad and flattened; 1 or 2 fringes of scales at sides of abdomen; ear concealed or not 8

8. One peripheral fringe of scales; occipital horn nearly horizontal to head axis; femoral pore series nearly meeting medially; ventral scales smooth; tympanum sometimes scaly (Fig. 90) .... *platyrhinos platyrhinos* (p. 313)

Two peripheral fringes; occipital horns at an angle of at least 45° with head axis; femoral pore series widely separated medially; ventral scales keeled; tympanum naked (Fig. 84) .... *cornutum* (p. 290)

9. Head spines very short; small, maximum snout-vent measurement 64 mm. (2½ in.) .... *douglassii douglassii* (p. 299)

Head spines longer; sometimes larger, reaching at least 96 mm. (3¾ in.) snout to vent 10

10. Head spines relatively large; occipital spines usually directed backward, parallel with temporals (Fig. 87); latter often reddish .... *douglassii hernandesi* (p. 304)

Head spines smaller; occipital spines parallel to temporals or not; temporal spines not reddish 11

11. Occipital spines parallel with temporals; maximum snout-vent length about 76 mm. (3 in.) .... *douglassii brevirostre* (p. 302)

Occipital spines more nearly erect than temporals; size often larger 12

12. Temporal and occipital horns smaller, shorter, more erect; infralabials smaller, narrower, more pointed; head more pointed, arched; general character very spinose; dorsal color frequently nearly a uniform gray .... *douglassii ornatum* (p. 307)

Temporal and occipital horns larger, longer, less erect; infralabials larger, broader, less pointed; head more rounded, more flattened; less spinose in character; a distinct pattern of various colors usually evident dorsally .... *douglassii ornatissimum* (p. 305)

Texan Horned Lizard *Phrynosoma cornutum* (Harlan)

(Fig. 84, p. 287; Pl. 74)

Range. Eastern Kansas and perhaps extreme western central Arkansas, south through most of Texas to northern Mexico, westward through southeastern Colorado and southeastern Arizona. Type locality—Great Plains east of the Rocky Mountains. (Map 20, p. 497.)

Size. The largest specimen recorded has a snout-vent measurement of 109 mm. (4¼ in.), but this is an exceptional size; specimens more frequently measure about 60 mm. (2⅜ in.). The head-body length is about 2½ times as great as that of the tail.

Color. Like most other horned lizards, this species has a very characteristic pattern. The ground color varies from a light yellowish brown to

brownish red or tan. The three chief features of the pattern are: first, a dark brown, elongate, white-edged, sharply outlined blotch immediately behind the head, one on either side of the middorsal line, the lower edge less well defined and extending onto sides of the neck; secondly, a series of 4 more or less rounded dark spots on either side of middorsal line on body (last at base of tail), each bordered posteriorly by a white streak, and each surrounding an enlarged spine; and thirdly, a distinct, white, middorsal streak extending from head onto base of tail, becoming indistinct distally on tail. There are also 3 more or less rounded dark spots, like those nearer the median line, on each side of body; these also surround spines and are fused with the para-

Pl. 74. *Phrynosoma cornutum*. A, C, 10 miles southeast of Comstock, Texas; male. B, Wilcox, Arizona.

vertebral spots of the corresponding side, producing a pattern of more or less undulating dark bars, light-bordered posteriorly. The keels on many of the dorsal spines may be brown. The limbs are rather distinctly barred, as is the tail; only the last 2 or 3 tail bars are unbroken medially.

Dark markings on the head may be very indistinct, but are usually evident and consist of a dark streak between orbits, another between superciliary spines, and another on each side between the superciliary and occipital spines; a distinct white bar precedes each transverse dark streak across top of head; snout dark; a dark line from eye to anterior temporal spines, and another from eye to penultimate chinshields of lower jaw, each preceded by a broad white streak; temporal region white; mid-occipital area gray.

The ventral surfaces are entirely white or cream, save for a few discrete, rounded, dark spots on the belly and sometimes on the chest and preanal region as well.

Scalation. See Fig. 84. Nostrils distinctly within canthus, supraorbital ridge terminating posteriorly with a short, thick, superciliary spine; a much enlarged occipital spine on each side; a minute interoccipital spine; 3 temporal spines, 2 posterior largest, forming series separate from occipital; a continuous series of chinshields increasing greatly in size posteriorly, separated by 2 rows of granules from infralabials; a distinct series of somewhat enlarged gulars on either side, with a short diagonal series of large gular scales; tympanum distinct; 3 groups of lateral gular spines.

Dorsal scales mostly very small, with scattered, enlarged, keeled spines; numerous keeled scales near middorsal line, but latter with only small scales; largest spines in a series on either side of middorsal line; 2 series of lateral abdominal spines, upper ones a little the larger; 1 series on either side of tail. All ventral scales keeled to a varying degree. Femoral pores poorly defined; postanal scales not well defined.

Recognition Characters. The keeled ventral scales distinguish this from all other United States horned lizards except the regal which has 4 instead of 2 occipital spines. The keeling seems to be somewhat difficult to discern sometimes, however, particularly in young specimens; the species may be identified also by the combination of a distinct tympanum, 2 rows of lateral abdominal spines, 2 very large occipital horns, and the presence of but 1 series of enlarged scales on the throat. Of course throughout most of the central plains the texan horned lizard is the only species of the genus that occurs.

Habitat. Terrestrial lizards occurring on almost any type of flat, dry land where vegetation is scanty. The soil may be rocky, sandy, or loamy. They are strictly diurnal.

Habits. One of the most peculiar characteristics of this and certain other horned lizards is that of ejecting blood from the eyes; this phenomenon has been well authenticated. Its function is primarily associated with "skin" shedding, secondarily with defense. Hibernation occurs in September or early October, with the first cold spells, and emergence the following spring takes place in April or early May. Mating follows promptly after emergence, and in late May or June the eggs, 23 to 37 in number, are laid at a depth of 5 to 7 inches in more or less dry soil or sand. The eggs hatch in 39 to 47 days.

The food frequently consists largely of ants, of which great quantities may be eaten. Other small insects and arthropods of many types, however, are eaten. They feed only when temperatures are warm, refusing to eat at temperatures at which other iguanid lizards eat readily.

Much other information on the natural history of the Texan horned lizards has been published in numerous journals, references to most of which are given by Burt (pp. 27–32).

Problems. Scarcely any United States lizard is better known, anatomically, histologically, experimentally, and otherwise. More than anything else to be desired is a competent summary of the investigations based on this species scattered in many journals over many years.

References. Burt, 1928, pp. 56–58, food (*Kans.*); *idem*, 1928, pp. 27–32, summary and references to natural history accounts (*Kans.*).

San Diego Horned Lizard *Phrynosoma coronatum blainvillii* Gray

(Fig. 86A–C, p. 289; Pl. 75)

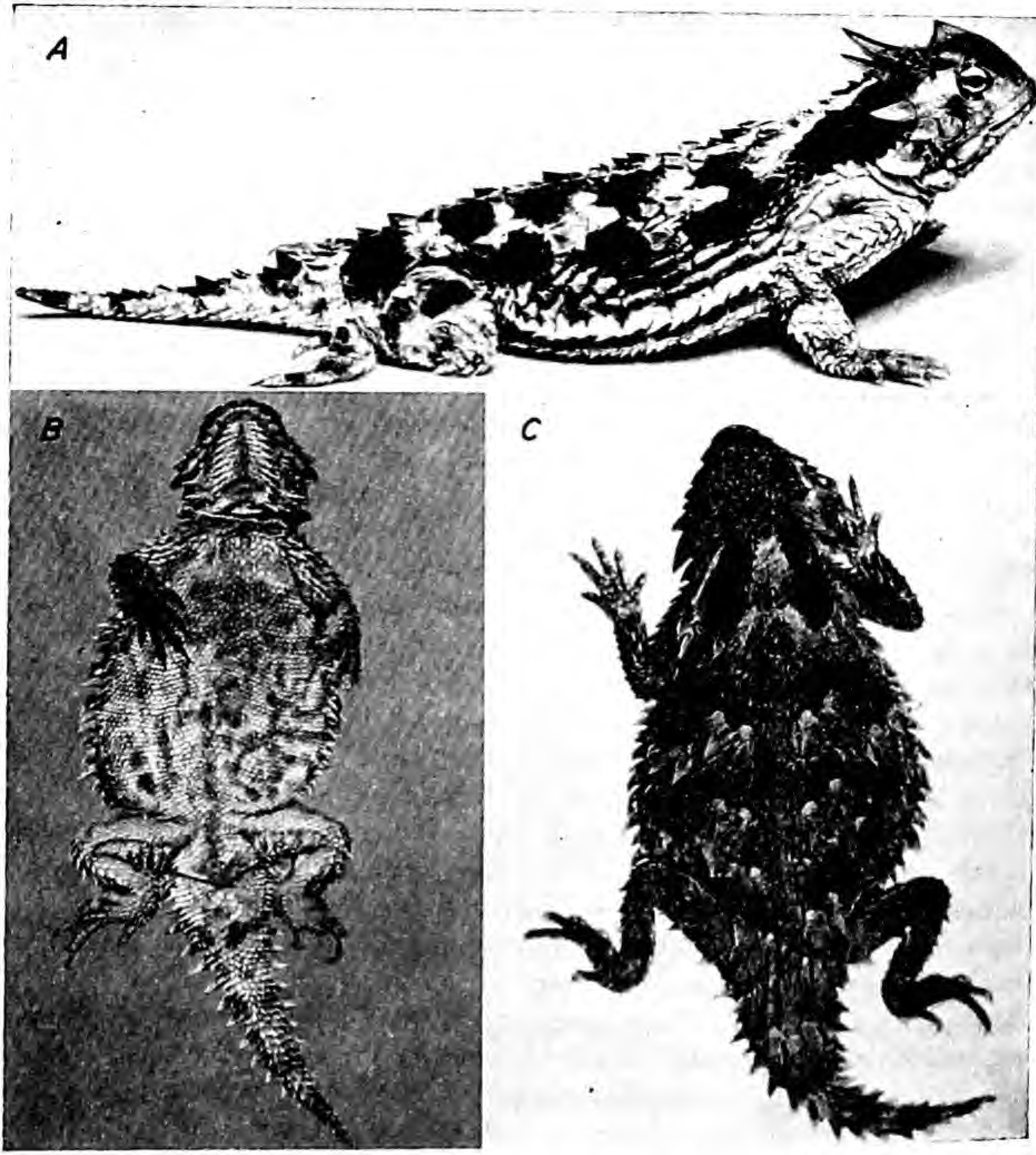
Range. Southern California, and northern Baja California west of the desert; southward from southwestern San Bernardino County to Lat. 31° N. Type locality—"California." (Map 22, p. 498.)

Size. Large adults measure about 100 mm. (4 in.) snout to vent; the tail varies somewhat in proportion but averages about ½ the snout-vent length. The maximum total length recorded is 161 mm. (6⅜ in.).

Color. The ground color above is yellowish or reddish gray, usually darker laterally. There is a large dark brown patch on either side of the neck, the two not widely separated from each other medially, each with a sharply defined medial border, but fading laterally into lighter ventral color. Three more or less undulate, much smaller, dark brown spots on either side of mid-dorsal line, each bordered posteriorly by a distinct light streak; a similar pair of marks at base of tail, and others on tail, but these less well defined. On sides of body, 3 other much less distinct dark spots occur. The head is more or less uniform, without dark marks, yellowish or slate-colored, distinctly lighter on snout. The larger spines are often reddish. There are no distinct bands on the legs. The ventral surfaces are white or cream, usually mottled to a varying degree with dark brown. The preanal region may be mottled, and the throat stippled irregularly. Ventral surfaces of limbs and tail unmarked.

Scalation. See Fig. 86A–C. Nostrils on a line with the canthus, but in advance of the distinct ridge above eye; latter ridge terminating posteriorly in an obtuse, short, superciliary spine; an elongate occipital spine on each side; 3 short interoccipital spines, 2 preceding a median posterior; 5 temporal spines, last largest, posterior 3 prominent, fourth usually quite small, the 5th but a little larger and on labial border. Scales on the top of the head smooth, convex, distinctly enlarged medially. A series of enlarged chinshields increasing in size posteriorly but abruptly decreasing again near end; a large, elongate, subrictal spine; a slender postrictal spine; at least 3 prominently enlarged, longitudinal series of pointed scales on each side of throat; 2 groups of enlarged tubercles on sides of neck; tympanum exposed.

Two series of enlarged, elongate scales on sides of abdomen, the scales in the lower series smallest; scattered, enlarged, keeled scales on back, tending to form longitudinal series; similar but lower scales in paravertebral region.



Pl. 75. *Phrynosoma coronatum blainvillii.* A, Ontario, California. U.S. Fish and Wildlife Service photograph. B, Japatul, California: male. C, San Diego County, California: male.

Ventral scales practically smooth, except near gular fold region. Femoral pores 12 to 18; postanal scales enlarged in males.

Recognition Characters. All others of this genus, with the exception of the closely related Californian horned lizard, either have very short horns on the head, the tympanum hidden, a single series of peripheral spines (or none), keeled ventrals, or only a single longitudinal row of enlarged throat scales on each side. Any of these characters will separate them from the San Diego horned lizard. The California horned lizard, however, which borders the

range of the more restricted subspecies on both the north and south, differs only in having rugose, striated, or rough plates on the middle of the head; these plates are also but little enlarged, whereas in the San Diego subspecies they are markedly enlarged.

Habitat. A terrestrial form, found in valleys, mesas, and foothills.

Habits. Ejection of blood from the eyes is known in this species as well as in others of the genus. Dogs and cats, which rather readily provoke the phenomenon, seem to be repelled by it.

Blood ejection is not the only means of defense which these lizards have. Occasionally when one is angered he will wriggle and twist about with his head in an endeavor to use his horns on the hand which holds him. They also open their mouths and hiss when annoyed, and often will jump toward the person who disturbs them. When they bite they hold on, but the resulting pinch is not particularly severe. Frank F. Gander reports that on two occasions males of this species have jumped at his foot and have bitten the sole of his shoe.

The horned toads in coastal San Diego County appear to have a very short season of intensive activity. This is in the spring from about April 15 to May 15. At this time—at least in primitive areas—they are quite common. This was the case, for example, in the Ojos Negros Valley of Lower California on May 5, 1935. Here, in the morning, one crossed the road in front of the car every hundred yards or so. They seemed to be as plentiful as any lizard there. But at other seasons, even in the cool coastal belt they appear very scarce.

This species occasionally perches on rocks for observation or to sun themselves. When the intruder approaches closely they run under the rock or into the nearest bush.

While the horned toads do not have separable tails like so many lizards, I have found two specimens with tails partly cut off.

This species has a considerable power of color change, and seem often to match the color of the soil or sand on which they are found (Klauber, 1939).

It has been suggested, and the suggestion questioned, that in mating the male turns the female over on her back. As with many lizards, the male bites and holds the skin at one side of the female's neck.

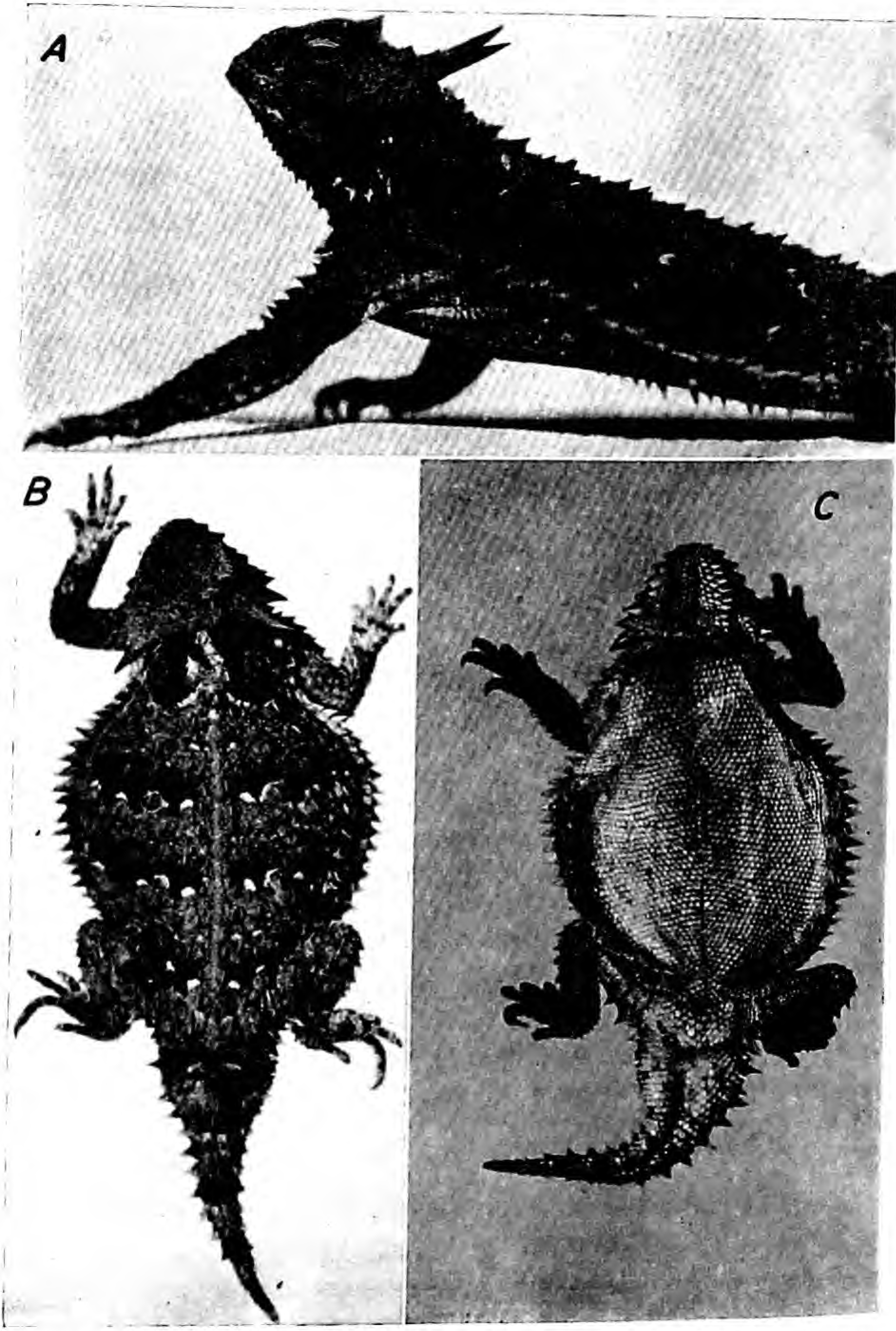
Problems. The paragraphs above give about all that is known of the natural history of this species. Obviously much more is to be desired.

References. Klauber, 1936, p. 110 (*lit. cit.*); *idem*, 1939, pp. 93–94 (*Ariz.*); Tevis, 1944, pp. 13–15, fig. 2, map (*lit. cit.*); Van Denburgh, 1922, pp. 388–395, pl. 32 (*gen. lit.*); Wood, 1936, p. 177 (*lit. cit.*).

Californian Horned Lizard *Phrynosoma coronatum frontale* Van Denburgh

(Fig. 20, p. 63; Fig. 86D, p. 289; Pl. 76)

Range. A discontinuous distribution, in the north occurring from the San Francisco Bay region and northern Sacramento Valley to northwestern Los



Pl. 76. *Phrynosoma coronatum frontale*. A, Coalinga, California; male. B, C, Fresno, California; male.

Angeles County, west of the Sierra Nevada. In the south, only in Baja California, west of the Sierra de Juárez and Sierra San Pedro Mártir, from Lat. 31° N. south to Lat. 29° N. Type locality—in the northern population, Bear Valley, San Benito County, California. (Map 22, p. 498.)

Size. About the same as the San Diego horned lizard; the maximum measurement recorded is 89 mm. (3½ in.) snout to vent.

Color. As in the San Diego horned lizard.

Scalation. See Fig. 86D. Like the preceding species with the exception of the fact that the median (frontal) scales are not conspicuously enlarged and are rugose, rough, or striated.

Recognition Characters. This species is very much like its close relative to the south, the San Diego horned lizard, from which it differs by having smaller frontal scales, which are rugose or striated instead of smooth and large.

Habitat. Like that of the preceding species. Occurs up to an elevation of at least 4500 feet.

Habits. Very little more than that recorded for the southern race is known. Blood ejection from the eyes has been noted several times. In Baja California Tevis records that "the five horned toads from the vicinity of San Quintín and the northern Santo Domingo were found on flat, sandy ground generally covered with low bushy growth. The inhabitants of Rosario said that horned toads are abundant on the sandy ground of the willow thickets. One that I noted on the arid, maguey-dotted plain above Rosario ran swiftly into a hole under a maguey and had to be dug out."

Problems. The life history and habits are very poorly set forth in published accounts. Moreover, the southern population in Baja California is well worthy of further study. Although it is not an unknown situation for the range of one subspecies completely to divide that of another, still it is distinctly unusual. With further study and specimens it may be possible to distinguish the isolated southern population from the northern one.

Reference. Tevis, 1944, pp. 13–15 (*lit. cit.*); Van Denburgh, 1922, pp. 395–401, pl. 33 (*gen. lit.*).

Hornless Horned Lizard *Phrynosoma ditmarsi* Stejneger
(Pl. 77)

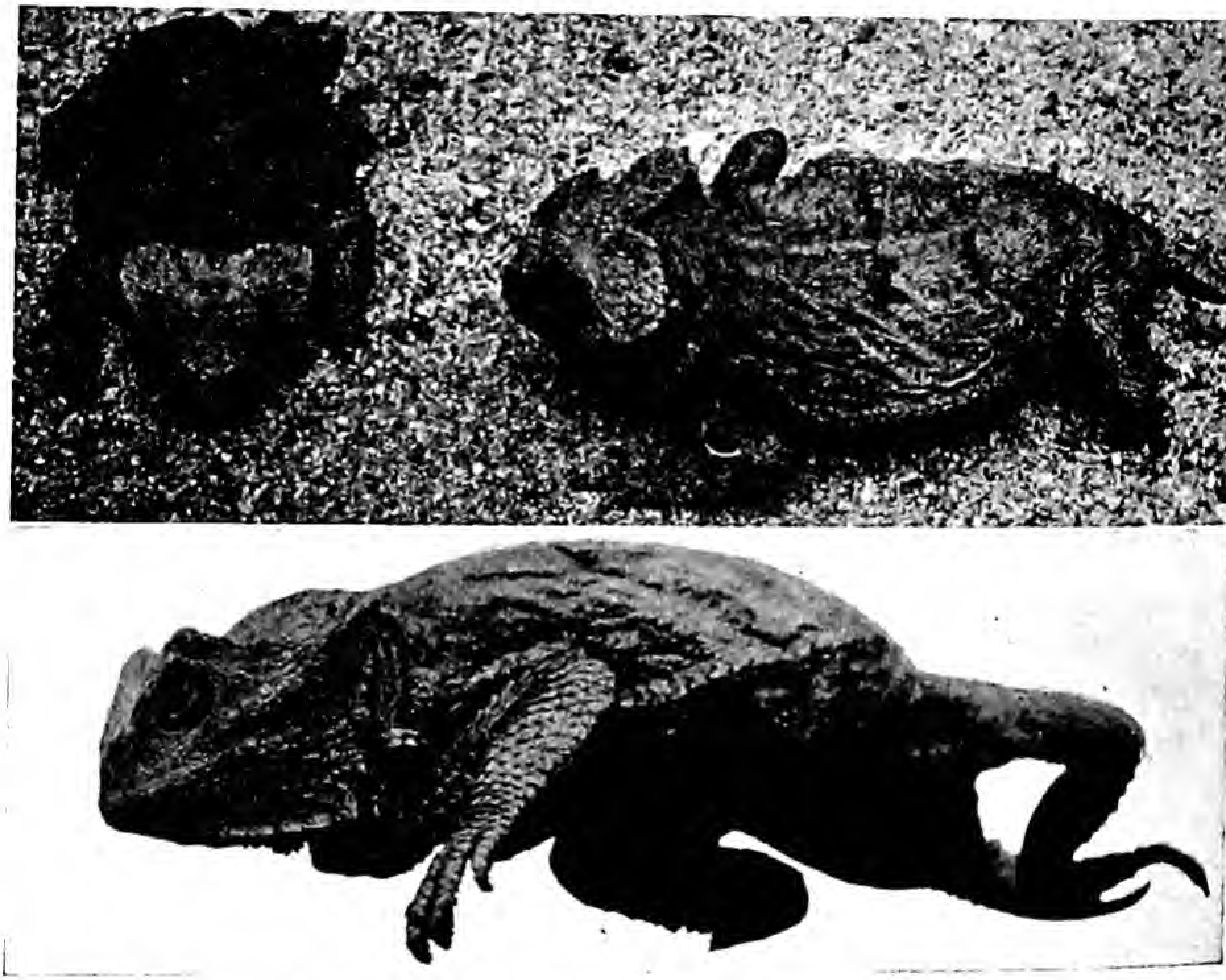
Range. Known only from extreme northern Sonora, but probably occurs in southern Arizona. Type locality—state of Sonora, Mexico, not far from boundary of Arizona. (Map 23, p. 499.)

Size. The largest of the two known specimens measures 76 mm. (3 in.) snout to vent, the tail 28 mm. (about 1 in.).

Color. Pale yellowish gray, reddish in life, with 3 faint, narrow, brownish,

transverse bands on the middle and posterior part of the back, and 1 on the base of the tail. Ventral surfaces whitish, with obscure, dusky spots.

Scalation. Head without horns; scales which form spines in other species appear in this as low protuberances; 2 rounded, flaring expansions on either side of head, separated medially by a narrow and deep notch; nostril placed on a line joining superciliary ridge with end of snout; supralabials small,



Pl. 77. *Phrynosoma ditmarsi*. Near the boundary of Arizona, state of Sonora, Mexico. Courtesy of New York Zoological Society.

subequal; infralabials small, but increasing somewhat in size posteriorly and becoming keeled; chinshields increasing in size posteriorly and becoming very widely separated from infralabials posteriorly; since the sublabials are in almost a vertical plane with the infralabials, the jaw becomes enormously deepened as the two series diverge posteriorly; scales between chinshields and infralabials rugose, as are those on dorsal surface of the head, and of about the same size as the latter; a series of enlarged scales medial to chinshields. Tympanum naked, but concealed behind a neck fold.

Dorsal scales on body and tail small, interspersed with scattered, larger, bluntly keeled scales; ventral scales strongly keeled; femoral pores 9 to 14; postanals enlarged in males. One series of lateral abdominal scales.

Recognition Characters. The almost complete reduction of the head spines, the enormous vertical development of the lower jaw, and the strong keeling on the ventral surface are characters identifying this as the most bizarre of the horned lizards.

Habits and Habitat. In its natural environment these are unknown. Dr. Raymond Ditmars kept a specimen alive for about a year, feeding it ants, grasshoppers, crickets, and meal worms.

When annoyed it would arch its back, point its snout downward, then make jumps of fully an inch from the ground, each jump accompanied by a miniature hiss which sounded like a sneeze. . . . Late in the afternoon it would so bury itself in the sand that only its nostrils and the crownlike top of the head were visible, and these so closely matched the color of the sand that close inspection was necessary to find it.

The rarity of this horned lizard might be accounted for in consideration of its relatively smooth skin and absence of head spines rendering it an easy prey for various snakes. Thus the general abundance of those species with bristling body spines and long horns upon the head might also be explained (Ditmars).

Problems. The first problem is to determine the normal habitat and habits of these creatures. For horned lizards, its elusiveness is unique.

References. Ditmars, 1936, pp. 67–68, pl. 18 (*gen. lit.*); Stejneger, 1906, pp. 565–567 (*lit. cit.*).

Pigmy Horned Lizard *Phrynosoma douglassii douglassii* (Bell)
(Pl. 78)

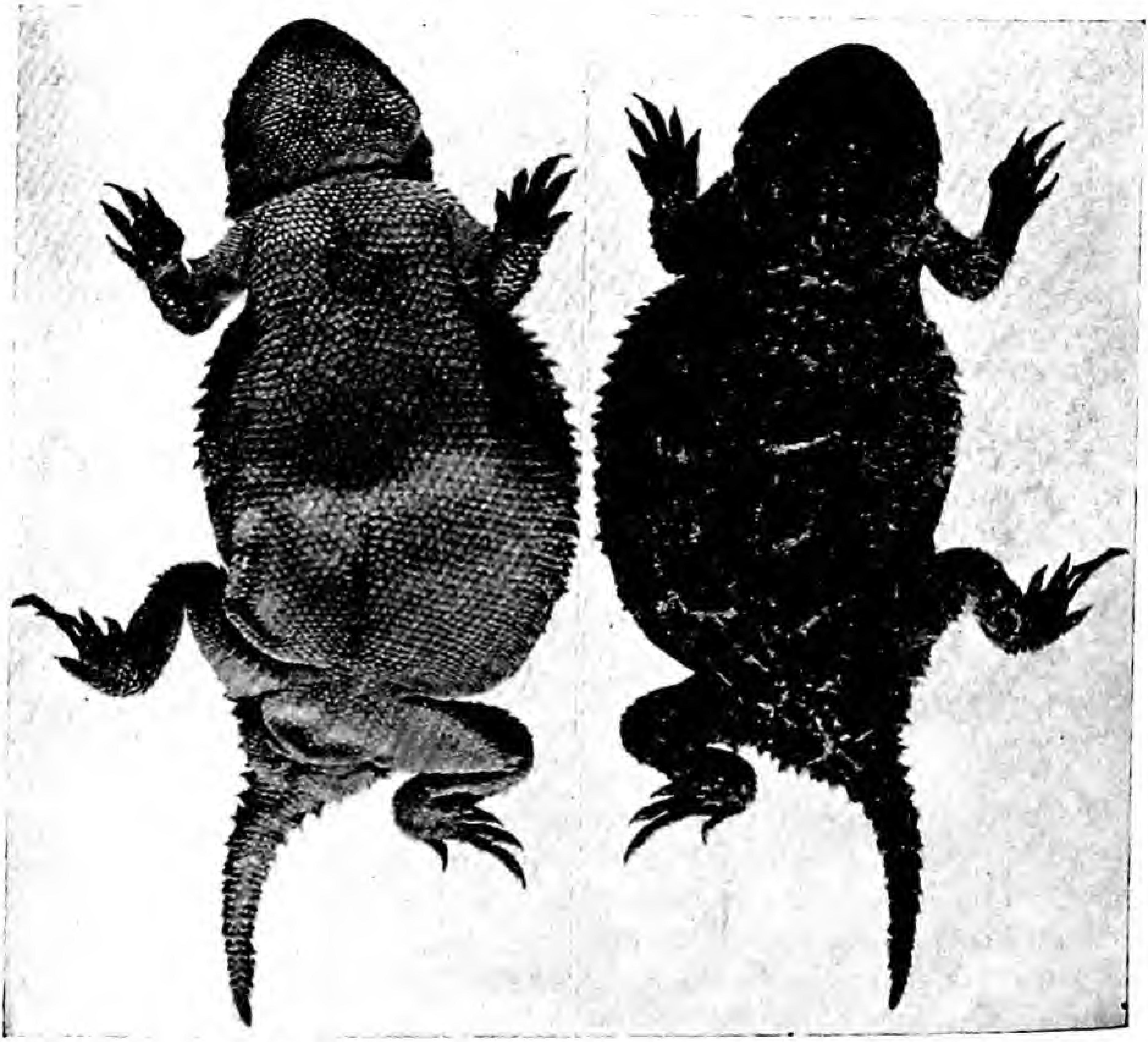
Range. Southern central British Columbia south through the eastern half of Washington and northern Idaho, Oregon east of the Sierra, and extreme northern California. Type locality—Columbia River. (Map 21, p. 498.)

Size. Maximum snout-vent measurement 64 mm. (2½ in.); tail a little less to a little more than ½ the length of head and body.

Color. Generally rather dull. Dorsal surface slate gray, brownish, or yellowish; three transverse rows of 2 to 4 indistinct dark blotches, those on either side of dorsal line more clearly defined; the blotches usually are light-edged posteriorly but anteriorly blend with the ground color. Tail banded above. A dull dark blotch on either side of neck, just behind head. Belly white or yellowish, sometimes faintly suffused with slate gray.

Scalation. Similar in many respects to that of *d. hernandesi* (Fig. 87). All horns on head very small; an occipital on each side, the two separated from each other by usually 5 scales; 3 or 4 temporals on each side, separated by 2 small scales from occipital; a superciliary spine visible. Nostrils pierced on the canthal ridge, or in line with it. Labials increasing somewhat in size posteriorly; chinshields separated from infralabials by not more than 3 or 4

rows of small scales, decreasing slightly in size at extreme posterior, elsewhere of about equal size. Gular scales nearly equal in size, smooth, flat, overlapping. A broad, granular, gular fold and preceding this a ventral fold between ear openings; several enlarged scales on a loose fold of skin on sides of neck between gular and intratympanic folds. Tympanum sometimes scaly and not easily discernible, at other times naked.



Pl. 78. *Phrynosoma douglassii douglassii.* Malheur Migratory Bird Refuge, Harney County, Oregon; female. U.S. Fish and Wildlife Service photograph.

Dorsal scales highly irregular in size, many enlarged and keeled, others (most of the scales) small and nearly or fairly flat; largest scales coinciding in position with dark blotches. Tail with 4 series of enlarged scales distally; hind legs with scattered, enlarged, protruding scales; front leg with numerous enlarged, keeled scales, but these are not protruding like those on the hind leg. A single fringe of elongate scales at sides of abdomen. Belly scales small, pointed, smooth, flat, overlapping. Femoral pores 16 to 20 on each leg, the

two series separated medially by very few (2 to 3) scales. Enlarged postanals sometimes (not always) present.

Recognition Characters. Within its range no other horned lizard occurs. Differences from the adjacent subspecies to the east, *d. ornatissimum,* involve the larger size and larger horns of the latter. However, never have the various subspecies of *douglassii* been satisfactorily defined, although authors almost universally agree that the extensive variation is correlated with geographic areas. Until the complex is studied in much more detail, and with much more care, than it has been in the past, the vague differences pointed out by previous authors and their local determinations must suffice for a basis of establishing lines between the ranges of the several forms presumably distinct.

Habitat. Anderson and Slater state that in Oregon the species occurs mainly in the Upper Sonoran zone, but also in the Canadian and Transition. Cooper says they are found on open plains, usually among rocks and sand.

Habits. Suckley (in Cooper) records a specimen which "when irritated would spring in a most threatening manner at anything pointed at it, at the same time opening its mouth widely, and audibly hissing, after which it would inflate its body and show other evident marks of anger."

Milne brings up an interesting question concerning the mating habits of this species. Since at least some male horned lizards belonging to species with long horns retain their positions on the females by grabbing an occipital horn in their mouths, males of *douglassii,* as well as of other short-horned species, must resort to some other means of stabilization. No matings have ever been recorded for this species. As in *c. blainvillii,* the neck skin may be held.

Problems. As mentioned above, the *douglassii* "complex" of the horned lizards is seriously in need of careful study; probably this is the outstanding problem remaining to be studied in the systematics of the United States lizards. Not only are the United States races in doubt, but also there is question of their relationship to another complex occurring in Mexico (*orbiculare* and its relatives). Klauber has published reasons for believing both complexes belong to but a single species, for which the name *orbiculare* would have to be used, since it is older than the name *douglassii.* The same conclusion was independently reached by Dr. L. C. Stuart (not published); and still another authority, Mr. C. M. Bogert, briefly reviewing the species, writes in a letter that he believes Klauber's arrangement probably correct. Thus all our United States races would be considered subspecies of *orbiculare,* as *orbiculare douglassii, orbiculare ornatum,* etc. Although it is clear that *orbiculare* and *douglassii* are closely related, together forming a distinct group of the genus, nevertheless I hesitate to unite the two complexes as a single species. In reviewing the problem several years ago I concluded that the time was not yet ripe to assume an intergradation between the northernmost race of *orbiculare* and the southernmost subspecies of *douglassii.* In fact, *douglassii* is

known from as far south in Mexico as Durango, where it is represented by an extremely short-tailed subspecies (*d. brachycercum*). Yet *orbiculare* is known from as far north as Chihuahua where the tail-body proportion remains as in southern Mexico, much greater than in *d. brachycercum* and higher than in most other *douglassii* subspecies. If there were a gradual decrease in tail-body proportion in *orbiculare* toward the north, intergradation of the two species would seem more likely.

Not only is the tail longer in *orbiculare* than in the geographically overlapping subspecies of *douglassii*, but in all forms of the former complex the occipital horns are distinctly (sometimes much) larger than the superciliary spines; in *douglassii* (all races) the superciliary and occipital horns are subequal in size.

Because of these facts I believe the assumption of common specificity of *orbiculare* and *douglassii* is not yet certain. The matter needs further study to prove the degree of relationship, however; it is by no means a closed subject.

References. Anderson and Slater, 1941, pp. 111, 114, 116 (*Ore.*); Cooper, 1860, pp. 294–295 (*Wash.*); Cowan, 1936, p. K20, British Columbia (*Can.*); Gordon, 1939, p. 68 (*Ore.*); Klauber, 1939, p. 63 (*Ariz.*); Milne, 1938, p. 200 (*lit. cit.*); Owen, 1940, p. 170 (*Wash.*); Van Denburgh, 1922, pp. 368–377, description, discussion, range, localities, synonymy, habits (*gen. lit.*).

Eastern Short-horned Lizard *Phrynosoma douglassii brevirostre* (Girard)

(Pl. 79)

Range. Western Kansas diagonally northward in the western central plains to northern central Montana and, presumably, southern Alberta and Saskatchewan. Type locality—Pole Creek, Nebraska. (Map 21, p. 498.)

Size. Maximum snout-vent measurement about 76 mm. (3 in.); tail about ½ head-body length or less.

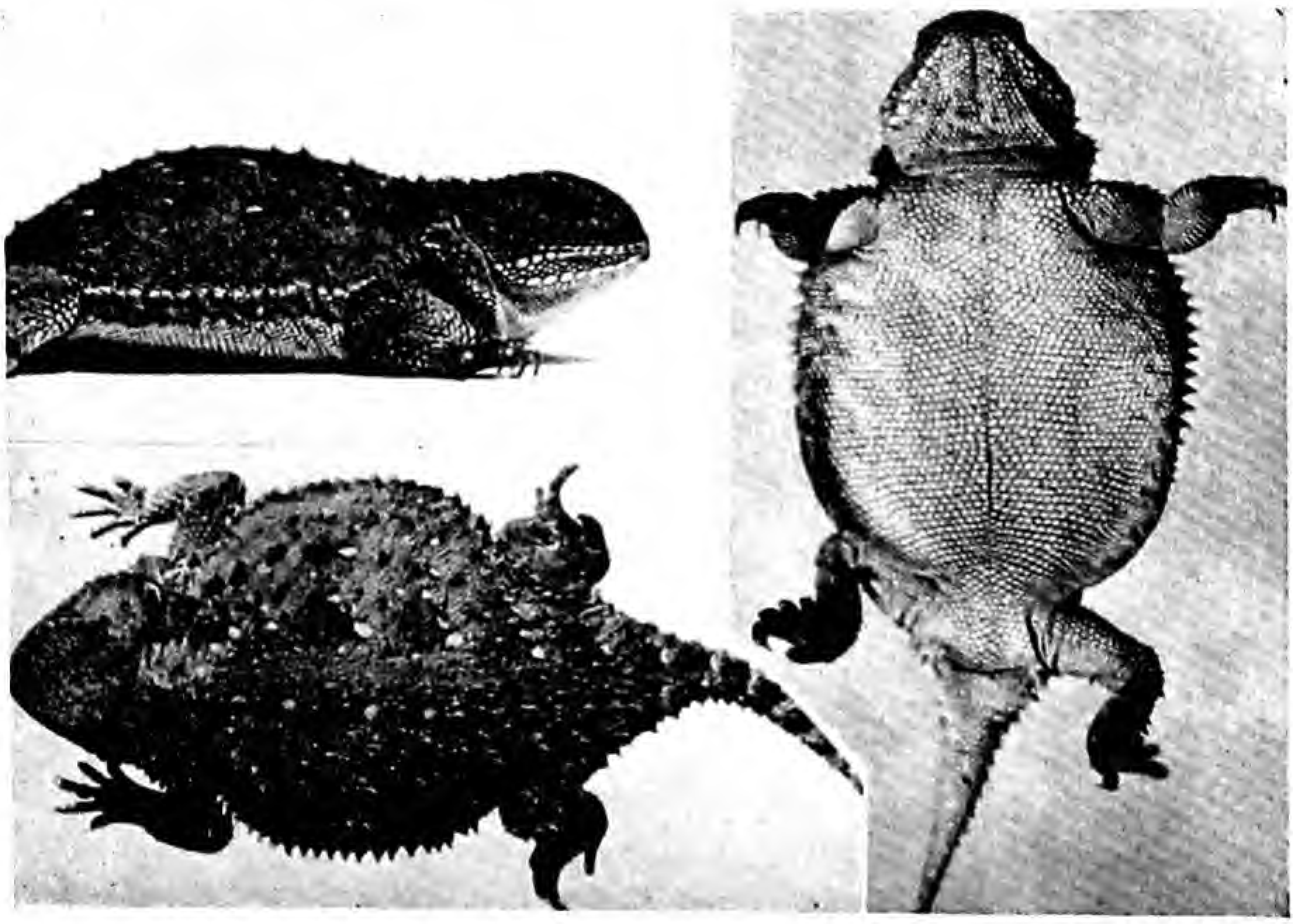
Color. Ground color gray or brown; on either side of middorsal line a series of 3 or 4 irregularly outlined dark blotches, and sometimes (especially in young) a similar outer series on each side. When present, the spots in the outer series are less well defined than those nearer the median line, and they may be more or less continuous with them. The median blotches are light-edged posteriorly but their anterior edges blend gradually with the ground color. There is a large, indistinct, dark blotch on either side of the neck immediately behind the head. The lateral fringe of spines is whitish. The belly is usually light, but may be black-speckled. The gular region is usually mottled with gray.

Scalation. Similar in many respects to that of *d. hernandesi* (Fig. 87). As in *d. douglassii* but spines on head larger, and the occipital spine parallel to

the temporals, not erect. So far as known the tympanum is always naked. The range in variation in femoral pore count is not recorded.

Recognition Characters. Within its range no other species of short-horned horned lizards occur. Comparisons with other races of *douglassii* are given in the key.

Habitat. In Nebraska they are "locally common in certain areas in the semi-arid short grass plains of the extreme western end of the state. They



Pl. 79. *Phrynosoma douglassii brevirostre.* Casper, Wyoming; female.

are usually found in fairly rough terrain. Large numbers have been taken around the fossil diggings near Agate and Hemingford" (Hudson)

Habits. Hudson found the diet to consist mostly of grasshoppers and ants, with a few beetles included. In spite of their small size they can swallow "fully winged grasshoppers well over an inch long."

The eastern short-horned lizard is known to give birth to the young. The broods contain some 5 or 6 individuals. Not impossibly are several broods carried at once, as Hudson records one female that contained "six young about ready to be born and four large eggs. The young measured about 1.2 inches."

Problems. Most authors have considered *brevirostre* a distinct species. Since its characters in their variation appear to overlap those of other races, how-

ever, and since it is by no means certain that the apparent isolation of *brevirostre* is real, there is little reason to hold it as a distinct species.

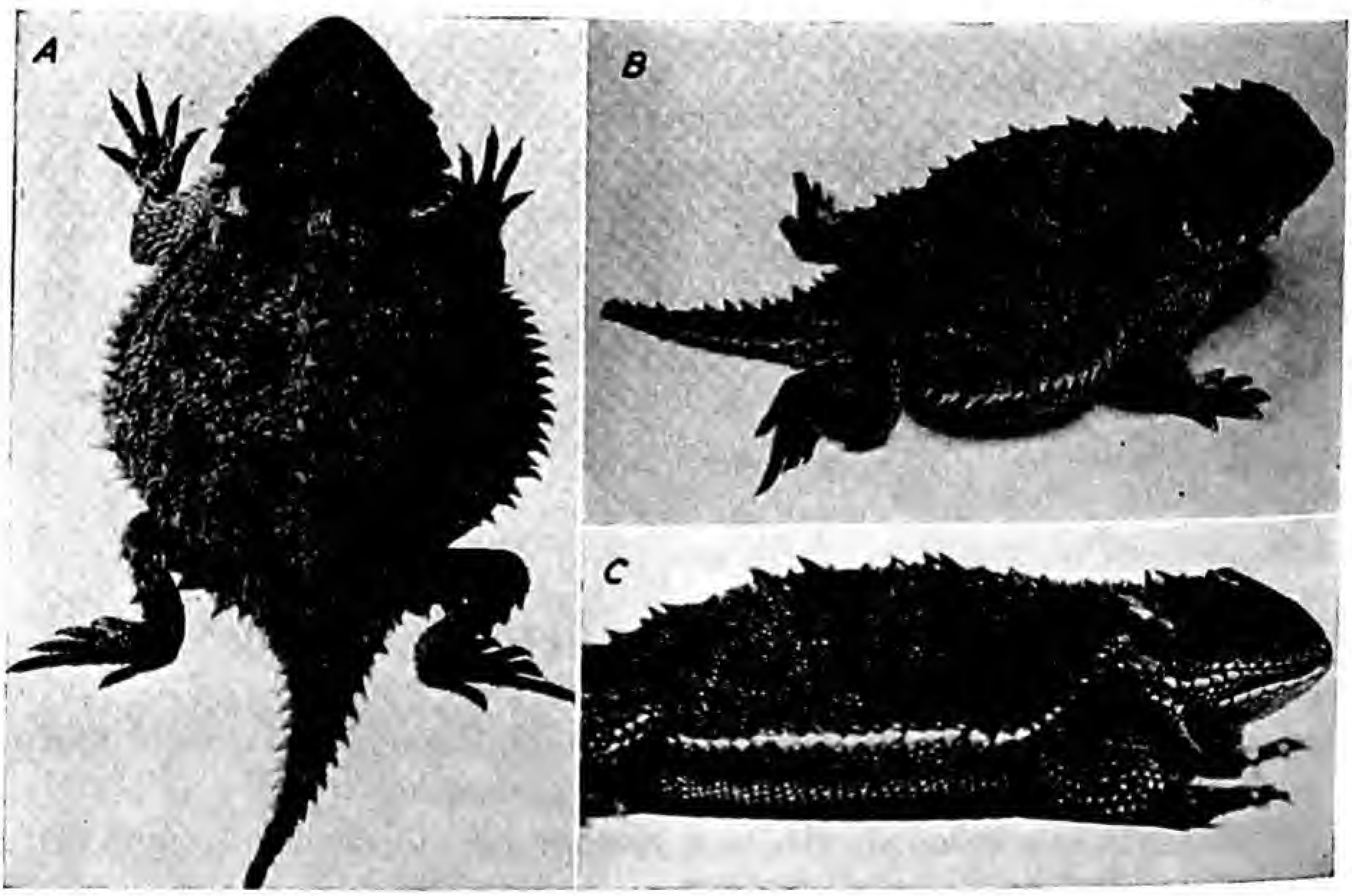
The race has never been adequately described or the variation recorded.

References. Burt, 1927, pp. 53–54, type locality (*lit. cit.*); Girard, 1858, p. 397, description (*lit. cit.*); Hudson, 1942, pp. 36–38, pl. 6, fig. 3, map 14, Nebraska, habits, habitat, localities (*Nebr.*); Stejneger, 1890, p. 113, status (*lit. cit.*).

Mountain Short-horned Lizard *Phrynosoma douglassii hernandesi* (Girard)

(Fig. 87, p. 289; Pl. 80)

Range. Mountains and plateaux of eastern and central Arizona south of the Grand Canyon region and Little Colorado River, of central southern and western New Mexico, and of extreme western Texas. Type locality—New Mexico. (Map 21, p. 498.)



Pl. 80. *Phrynosoma douglassii hernandesi*. A, B, Dos Cabezas Mountains, Cochise County, Arizona. U.S. Fish and Wildlife Service photographs. C, Cloudcroft, New Mexico.

Size. Maximum snout-vent measurement 96 mm. ($3\frac{3}{4}$ in.); tail a little less to a little more than $\frac{1}{2}$ the length of head and body.

Color. As in *d. brevirostre* except dark neck blotch large and distinct; head often pinkish or yellowish, and the temporal regions reddish; ground color

variable, sometimes reddish or yellowish; belly frequently mottled or suffused with gray.

Scalation. See Fig. 87. As in *d. douglassii* except horns on head larger; occipital horns usually parallel with temporals, seldom erect. Femoral pores 11 to 19 on each side.

Recognition Characters. The relatively short horns and single fringe of scales on the sides of the abdomen will separate this from any other species of horned lizards occurring within its range.

Habitat. Piñon-cedar and pine-spruce associations of mountains and plateaux from about 500 to 9500 feet in elevation.

Habits. Usually these lizards are found on sunny days as they move about on the ground. Like other horned lizards they are easily captured.

The food consists of ants and other small insects as a rule, although large beetles and snails are eaten at times. One specimen has been recorded as eating young of its own species.

Dodge states that specimens sometimes showed considerable spirit, rushing at his foot with open mouth, hissing viciously. He cites two Hopi Indian myths which attribute to the animal great healing power and ability to bring large families.

The young are born in July and August and number 8 to 30.

Problems. The distribution of this subspecies is not well known, especially toward the north, where its range meets that of *d. ornatissimum*. Little has been recorded of its natural history.

References. Dodge, 1938, pp. 31–33, fig., habits, habitat (*Ariz.*); Ruthven, 1907, pp. 542–544, description, variation, habitat (*Ariz.*); Smith, 1941, p. 114, birth (*lit. cit.*); Van Denburgh, 1922, pp. 382–385, pl. 31, description, variation, broods, synonymy, localities, range (*gen. lit.*).

Desert Short-horned Lizard *Phrynosoma douglassii ornatissimum* (Girard)

(Pl. 81)

Range. Northwestern New Mexico diagonally northward through northern Arizona and southwestern Wyoming to central and western Idaho and presumably southwestern Montana. Type locality—mountainous region of New Mexico. (Map 21, p. 498.)

Size. Maximum snout-vent measurement about 84 mm. ($3\frac{5}{16}$ in.); tail a little more or less than ½ the length of head and body. The greatest total length recorded is 128 mm. (5 in.). The race is apparently smaller than *d. hernandesi.*

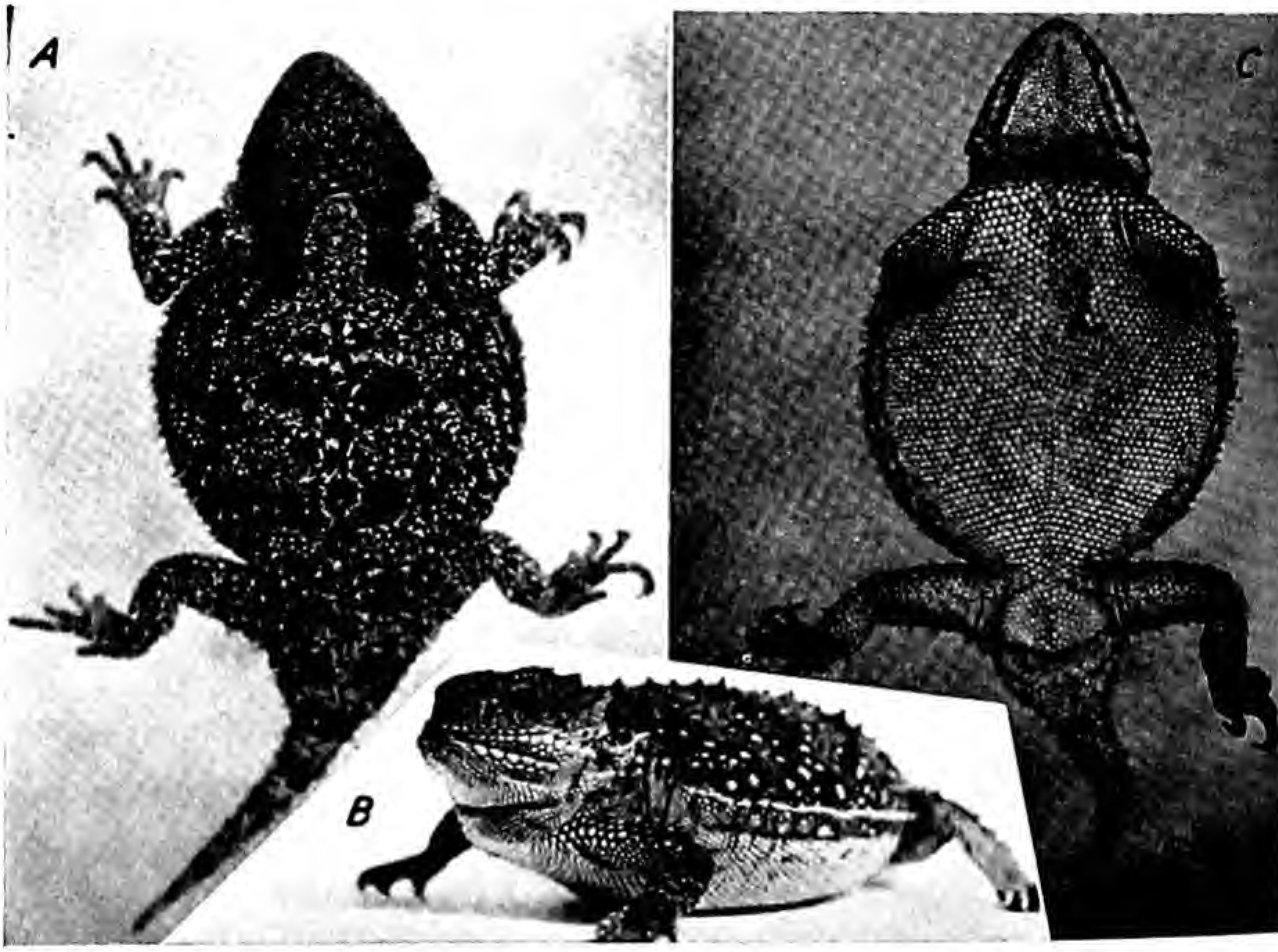
Color. As in *d. hernandesi* except head not reddish.

Scalation. As in *d. hernandesi* (Fig. 87) except tympanum sometimes scaly instead of naked; femoral pores 13 to 18; occipital horns more nearly erect.

Recognition Characters. The short horns and single fringe of scales on the sides of the abdomen separate this subspecies from any other horned lizard occurring within its range.

Habitat. Plains and mountains to elevations of at least 9000 feet above sea level.

Habits. In Nevada, Ruthven and Gaige observed that



Pl. 81. *Phrynosoma douglassii ornatissimum.* A, Walnut Canyon, Arizona. B, Colorado. C, Walnut Canyon, Arizona; male.

as a rule the horned toads were found during the warmer parts of the day. At night they burrowed beneath the surface of the ground. The adults kept rather closely to the shelter of the bushes, in which situation their coloration is quite protective as they very closely resemble the lumps of earth spotted with shadows which are common in this habitat. The young seem to roam about more than the adults, at least they were found more often in the open. Owing to their form and the absence of markings they look very much like small lumps of earth in the sunshine.

The food consists largely of insects, the bulk of which is ants. Velvet ants, beetles, grasshoppers, larval moths, and butterflies, as well as numerous other kinds of insects, are also taken.

Mating has been recorded in middle April. The young are born in August, and number from 8 to 12 or more.

Problems. The distribution, characters, and areas of intergradation with adjacent subspecies are not well known, as mentioned previously.

References. Ellis and Henderson, 1915, p. 260, Colorado records, as *P. h. hernandesi* (*Colo.*); Knowlton, 1934, p. 1002, food; *idem,* 1942, p. 602, food; Knowlton and Janes, 1933, p. 1015, food; *idem,* 1934, p. 12, figs. 1 A,B, food; Knowlton and Thomas, 1934, p. 258, food; *idem,* 1936, p. 65, food; (all *lit. cit.*); Linsdale, 1940, p. 232, fig. 16, map, Nevada localities (*Nev.*); Ruthven and Gaige, 1915, pp 23–25, habits, habitat, Nevada (*Nev.*); Slater, 1941, p. 93, Idaho records (*Idaho*); Stuart, 1932, p. 30, habitat (*Utah*); Van Denburgh, 1922, pp. 377–381, pl. 30, description, synonymy, range, localities (*gen. lit.*); Woodbury, 1931, pp. 47–49, figs. 16–17, Utah, description, habits, habitat (*Utah*).

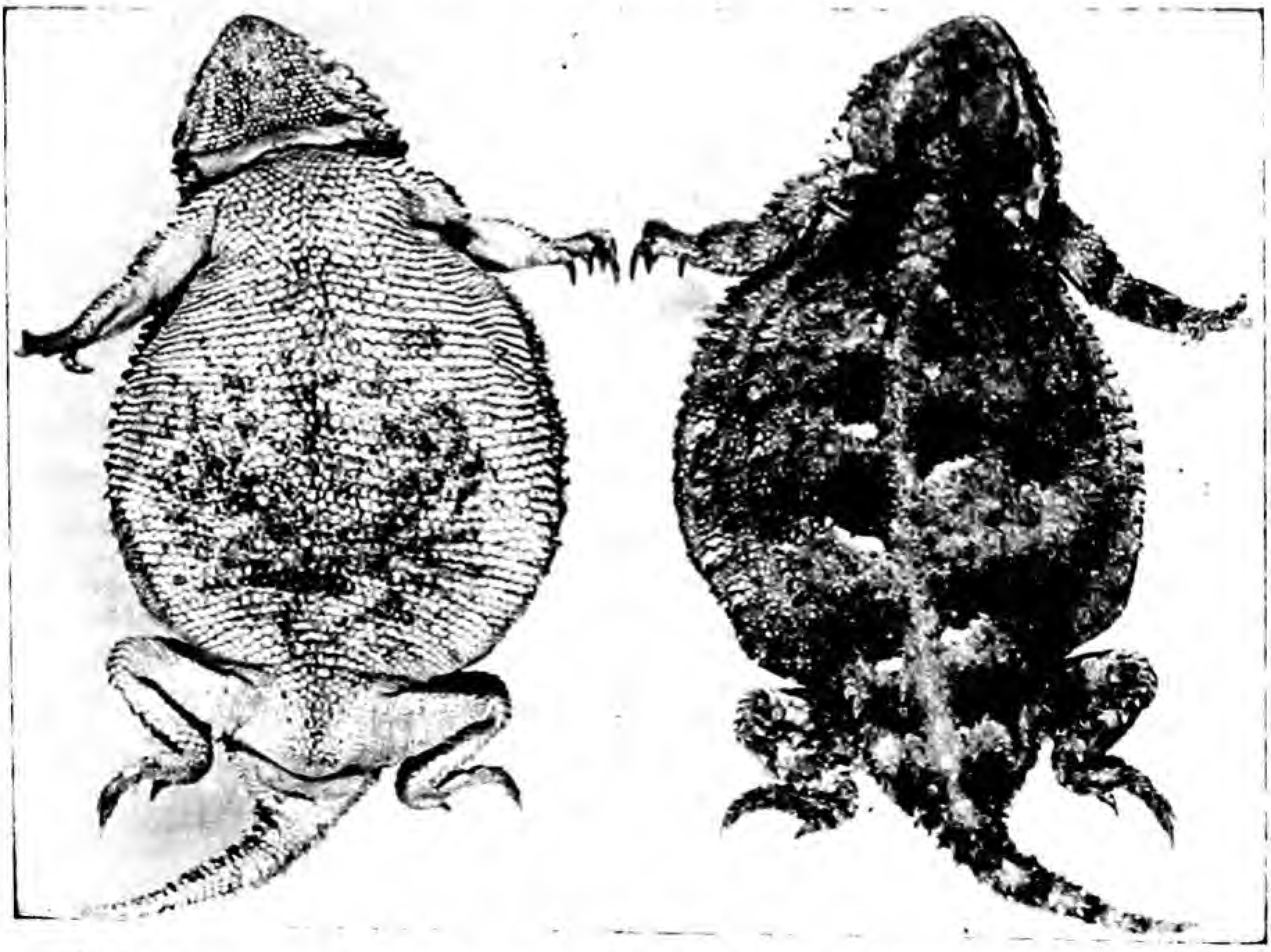
Salt Lake Short-horned Lizard *Phrynosoma douglassii ornatum* Girard (Pl. 82)

Range. The Salt Lake basin. Type locality—Salt Lake. (Map 21, p. 498.)

Size. Probably as in *d. ornatissimum.*

Color. Frequently nearly uniform gray; when a pattern is evident, it is like that of *d. ornatissimum,* with large, indistinct, dorsal spots.

Scalation. As in *d. ornatissimum* except as stated in the key (p. 290). Most characters are like those shown in Fig. 87 for *d. hernandesi.*



Pl. 82. *Phrynosoma douglassii ornatum.* Salt Lake Valley, Utah. Maas photographs.

Recognition Characters. The only other horned lizard occurring in the same area is *P. platyrhinos,* which is most easily distinguished by the much larger posterior chinshields and the larger head spines.

Habitat. Semiarid, alkaline flats amongst Russian thistle, shadscale, sagebrush, greasewood, etc.

Habits. The food consists largely of ants, although many other kinds of insects are eaten.

Eight to 14 young are born in August. Pack suggests that they are usually born between 6:00 P.M. and 7:30 A.M. At birth they weigh 0.5 to 0.9 grams and before hibernation double or triple this weight.

Problems. Not all authors agree that the Salt Lake Valley specimens are different from *d. ornatissimum;* as for other subspecies of *douglassii* a careful study is necessary.

References. Knowlton and Janes, 1932, p. 470, food (*lit. cit.*); Pack, 1918, pp. 91-92, habitat, food, broods (*lit. cit.*); Stejneger, 1919, p. 4, status (*Utah*); Tanner, 1928, pp. 26–27, characters of race (*Utah*); *idem,* 1942, p. 60, birth weights and prehibernation growth (*lit. cit.*).

Flat-tailed Horned Lizard *Phrynosoma m'callii* (Hallowell)

(Fig. 88, p. 309; Pl. 83)

Range. Extreme southeastern California and southwestern Arizona, northwestern Sonora, and probably northeastern Baja California. Type locality—Colorado Desert between Vallecita and Camp Yuma, 160 miles east of San Diego, California. (Map 20, p. 497.)

Size. Specimens reaching a length of 81 mm. (3³⁄₁₆ in.) have been recorded. The tail varies from a little less to a little more than ½ the head-body length.

Color. Very light gray, nearly white, to yellowish olive above. A narrow, dark, vertebral stripe, extending from the frontal region of the head to the rump. A brown blotch on each shoulder, just above arm insertion. Two series of small, rounded, brown blotches on either side of back, each surrounding a large spine; on the tail these fuse to form a series of dim crossbands. The limbs and head may be sparsely speckled. Lower surfaces white, unmarked.

Scalation. See Fig. 88. Two very long occipital horns; 3 temporal horns, the 2 posterior very elongate, the last narrowly separated from others; temporal horns more or less continuous with a series of subocular horns; an obtuse superciliary spine, and a number of other scattered, low spines; nares very markedly within the line of the canthi; infralabials small, separated by an incomplete row of tiny scales from a series of elongate, protruding, chinshield spines decreasing in size anteriorly. A longitudinal series of slightly enlarged scales on either side of throat, halfway between the midline and chinshields;

2 separated, elongate spines on either side of middle gular region behind head; a group of spines on sides of neck. Chest scales abruptly differentiated from granular gulars, somewhat larger than belly scales, keeled and a little protruding. Belly scales feebly keeled. Tympanum and ear opening not discernible.

Dorsal scales minute, certain scattered ones enlarged, keeled, protruding; a series of flat scales on either side of vertebral line; a series of slender spines

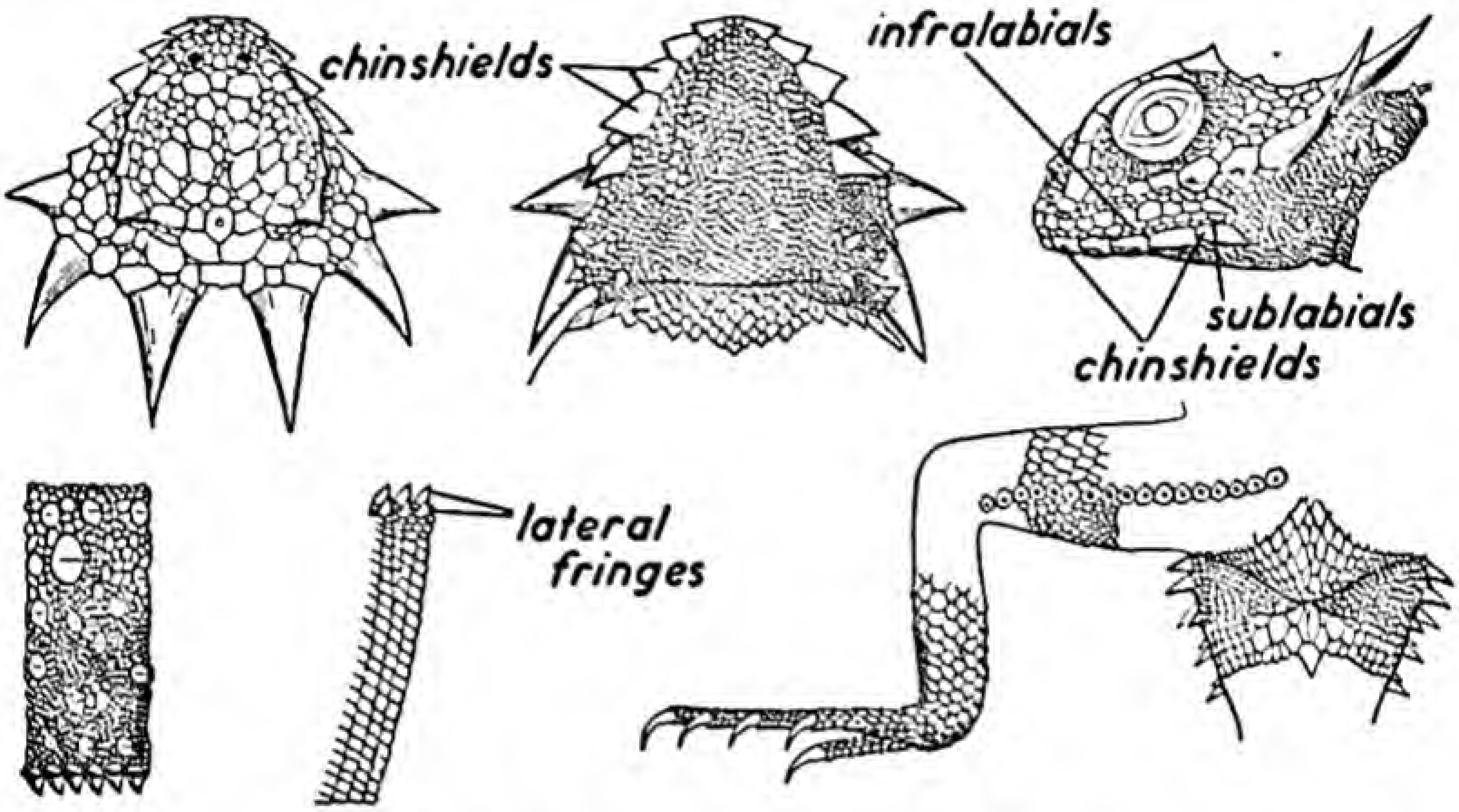


FIG. 88. *Phrynosoma m'callii.* From Cope.

along sides of body, separated by a narrow granular area from belly scales; some of the extreme lateral belly scales enlarged, keeled, but not forming a regular series. Tail broad, flat, with a series of enlarged flat scales on either side of the midline; a series of slender scales along side of tail; a group of similar spines on either side of anus and at base of tail on the ventral surface. Femoral pores 17 to 23.

Recognition Characters. The dark vertebral streak, the absence of an ear opening, the large flat tail, and the very elongate occipital horns are all characteristic of this species and distinguish it from all other horned lizards.

Habitat. "Sand hills," "sandy, gravelly desert," or "level or undulating sand with richer vegetation" summarize the published accounts of the habitat.

Habits. Like many other horned lizards, the food consists, to a very large extent, of ants. "One was found sitting on an ant hill, but not an ant was in sight although a half hour later they were swarming over it. It seemed as though the ants remained under cover in the nest as long as the lizard was watching them" (Van Denburgh).

[Klauber] found this species most plentiful in midmorning in late April and the first week of May. Like many species of horned toads, they usually spend the night just below the surface of the sand. They cover themselves by violent wriggles,

Pl. 83. *Phrynosoma m'callii.* Near Tin Horn, California; male.

without going forward. While tame, like all the horned toads, the horns of its head are so sharp that it can pierce the skin as it wriggles trying to escape. The stomach of a specimen from Harper's Well contained nematodes.

Wood's notes on egg laying in *m'callii* must refer to some other species, for *m'callii* does not occur at Tucumcari, New Mexico, whence the specimen was said to come. By inference the notes may apply to *cornutum,* the only long-horned horned lizard known in New Mexico.

Problems. The generic status of this species—whether it deserves a separate genus, *Anota*—is an attractive problem. The life history is also little known.

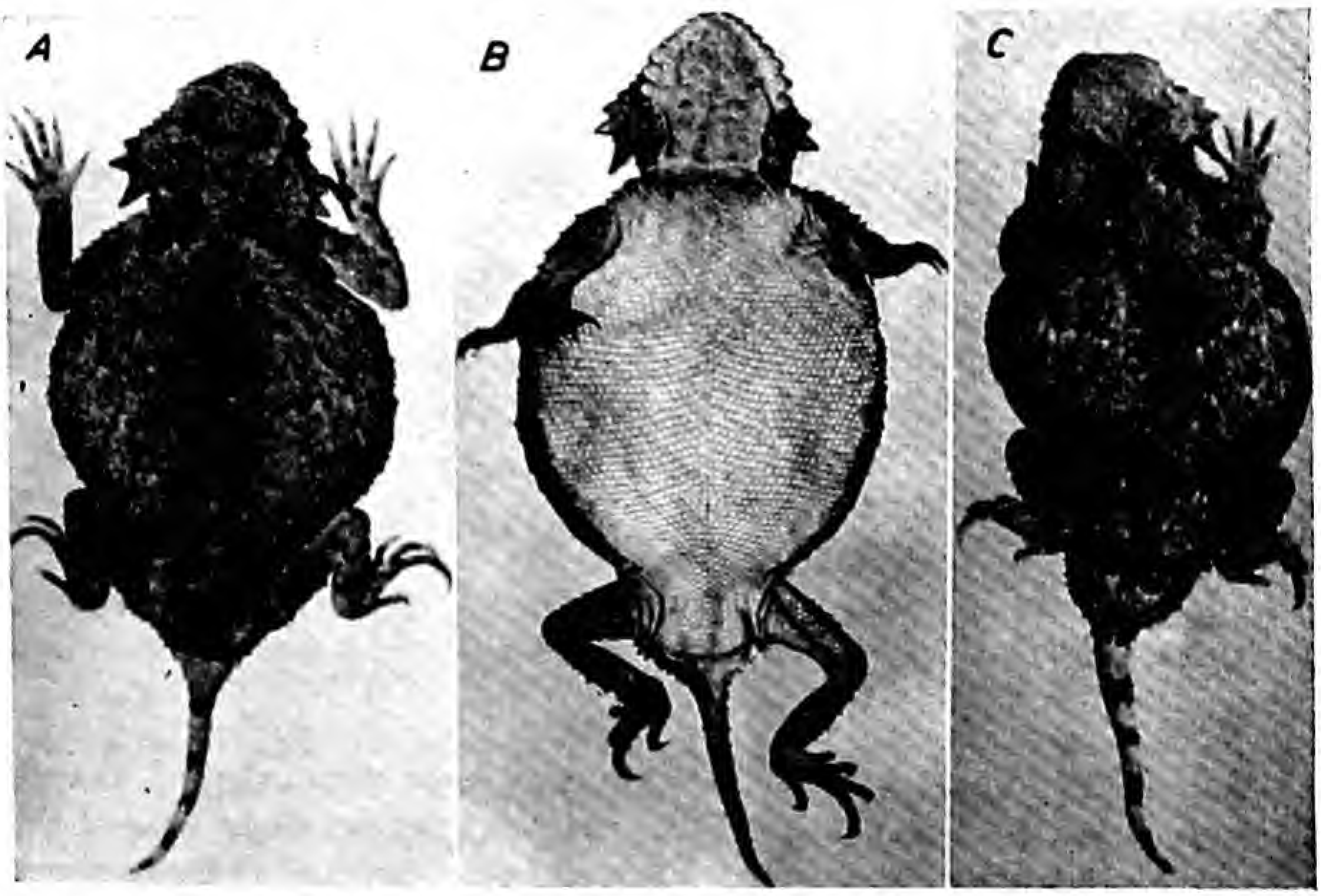
References. Klauber, 1939, pp. 33, 65, 75, 80, 83, 95, table 5, habits, habitat, localities (*Ariz.*); Van Denburgh, 1922, pp. 428–430, pl. 37, description, localities, habits (*gen. lit.*); Wood, 1936, pp. 69–70 (*lit. cit.*).

Bleached Horned Lizard *Phrynosoma modestum* Girard

(Fig. 89, p. 312; Pl. 84)

Range. Western Texas to southeastern Arizona, northward to northern New Mexico and perhaps southern Colorado, southward to central Sonora, central Zacatecas, northern San Luis Potosí and central Nuevo León. Type locality—Rio Grande west of San Antonio, Texas, and between San Antonio and El Paso. (Map 22, p. 498.)

Size. A rather small species, reaching a maximum snout-vent length of



Pl. 84. *Phrynosoma modestum.* A, B, Deming, New Mexico; female. C, El Paso, Texas; male.

about 68 mm. (2 11/16 in.). The tail varies from a little less than ½ to ⅔ the head-body length.

Color. The markings of this species generally are distinctive. The ground color varies from very light gray and yellowish gray to light brown. On each side of the neck is a large, dark brown blotch, extending to head and nearly meeting each other medially. There is a large dark spot in the groin, extending forward on the sides nearly halfway to the axilla, and narrowly separated from its mate in front of the rump. A similar blotch is present on either side of the base of the tail. All these markings may be very dim, or even absent; most constant of all are the neck blotches. The tail has narrow dark bands

above, and on the body there may be dim, narrow, dark crossbands. The ventral surfaces are white, unmarked.

Scalation. See Fig. 89. A relatively short occipital spine on each side; a somewhat shorter posterior temporal spine, and a series of 5 other temporal and subocular spines extending in a series to below middle of eye, decreasing in size anteriorly; no ear opening; nares distinctly within canthi; infralabials in contact with a series of 7 enlarged, blunt chinshields; no enlarged gulars; 2 groups of slightly enlarged scales on sides of neck. Ventrals perfectly smooth, flat; femoral pores 10 to 15; males with or without enlarged postanals.

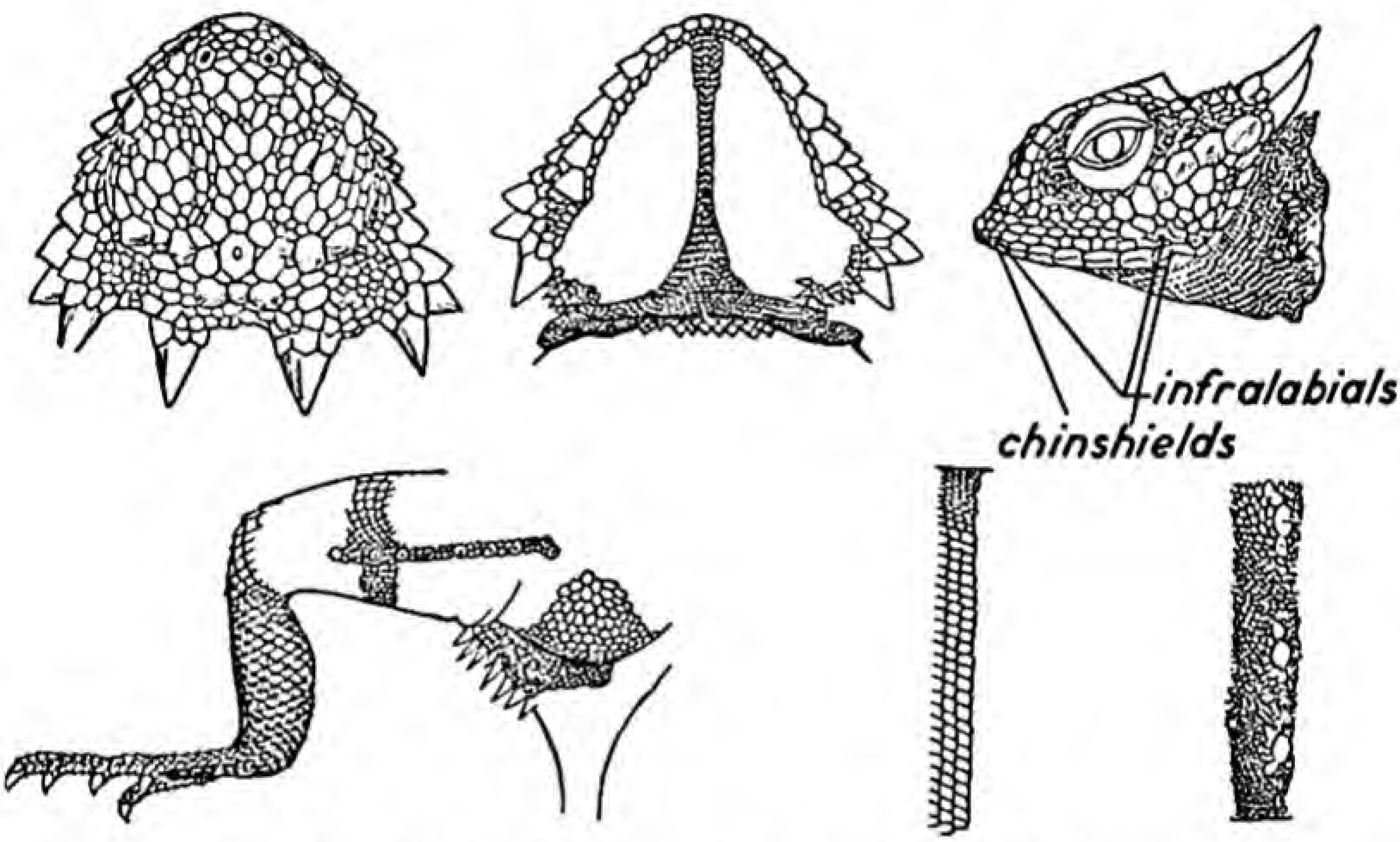


FIG. 89. *Phrynosoma modestum.* From Cope.

Dorsal scales small, irregular in size, interspersed with enlarged, keeled, slightly elevated scales, not spinelike; no series of spines along sides of abdomen or tail; scattered enlarged scales on tail; a series of elongate spines near either side of anus on base of tail.

Recognition Characters. The absence of a lateral fringe of scales and of a visible tympanum, and the short horns distinguish this small species from all other United States horned lizards.

Habitat. Desert plains amongst shrubby vegetation, on gravelly soil.

Habits. Little is recorded. They are sedentary lizards, remaining in a spot until one approaches within a very few feet. They make short, quick runs and are so well protected by concealing coloration that they are usually seen only because they run from almost under foot. Cope found them abundant in New Mexico in August, but saw none in a two-day visit in June.

The food consists largely of ants, but beetles have been found in their stomachs. Cockerell reports that a western collared lizard ate two of these horned lizards.

The ability to change color is very great. The black lateral spots may vary greatly in intensity and even become pink under certain conditions. Cockerell says some specimens are bluish in color.

Nematodes are commonly harbored in the stomach.

Problems. The natural history has not been studied.

References. Cope, 1883, pp. 10, 12 (*lit. cit.*); Ruthven, 1907, pp. 550–552, color variation, habits, habitat (*Ariz.*); Van Denburgh, 1922, pp. 430–433, pl. 38 (*gen. lit.*).

Desert Horned Lizard *Phrynosoma platyrhinos platyrhinos* Girard

(Fig. 90, p. 315; Pl. 85)

Range. Southeastern Washington and Idaho southward to northeastern Baja California, and from eastern California westward to western Utah and western Arizona. Type locality—Great Salt Lake. (Map 23, p. 499.)

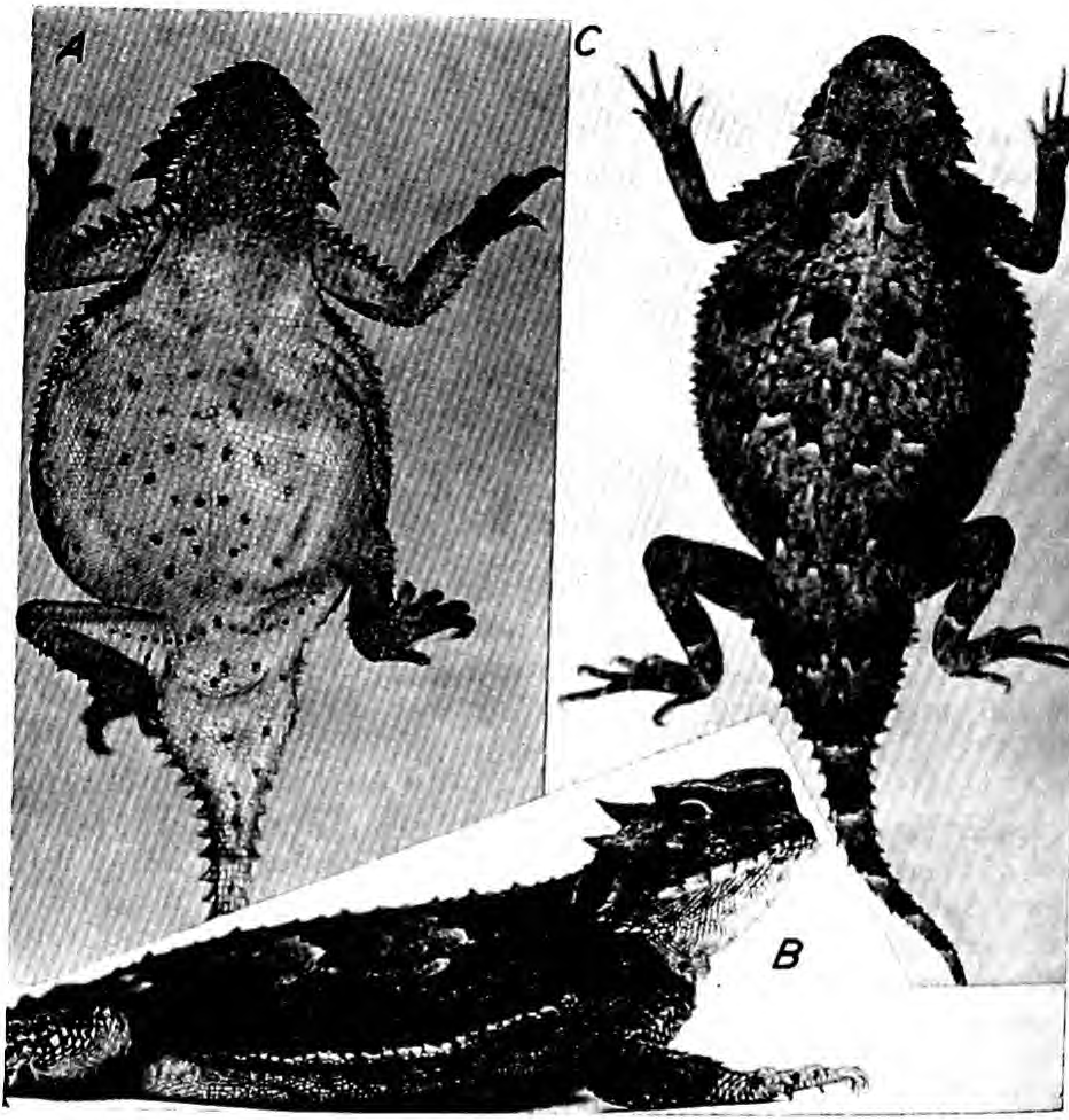
Size. A rather large species, reaching at least 94 mm. (3¾ in.) from snout to vent. The tail is about ½ the head-body length, or a little less.

Color. Markings usually rather bright, well defined. A narrow, light, vertebral streak usually evident; on either side of this, on neck, is a large black blotch, white-bordered medially, with a sharply defined, curved, posteromedial border. Three or 4 dark, undulating blotches on either side of back, extending halfway to edge of abdomen; these bands grading into the ground color anteriorly but with sharply defined, white-edged, coarsely denticulate, posterior borders. In a large, median, oval area, excluding the sides of the abdomen, are scattered white spots partly separated from each other by short brown lines. The sides of the back are more nearly a uniform light brown, with some evidence of the median crossbands. The tail is similarly banded. The hind legs have a few fairly distinct bands; the forelegs are nearly uniform. There are flecks of dark color on the head.

The ventral surfaces are white; the gular region is dotted with a few small, distinct, black spots; the posterior part of the belly, the subcaudal surface, the preanal region, and the posteroventral surface of the thigh are similarly marked; the chest may not be spotted.

Scalation. See Fig. 90. A moderate occipital horn on either side; a continuous series of smaller temporal and subocular spines, smaller anteriorly; an obtuse superciliary spine; other head scales rugose; nostrils within canthi; infralabials separated by 1 or 2 rows of small scales from a series of 7 or 8 enlarged, keeled, obtusely pointed chinshields; gular scales equal, save for a feebly defined ridge laterally near the posterior chinshields; 2 groups of spines on sides of neck; tympanum either scaly or naked; ventrals smooth, flat; femoral pores 6 to 12, extending far onto preanal region; enlarged postanals present in males.

Dorsal scales small, interspersed with numerous enlarged, pointed spines



Pl. 85. *Phrynosoma platyrhinos platyrhinos.* A, San Diego County, California; male. B, 22 miles north of Ajo, Arizona. C, Monroe, Utah.

frequently not keeled; a fringe of short spines on edge of abdomen; scattered spines on tail; a diagonal series of spines near anus on each side of base of tail.

Recognition Characters. The single row of spines in the lateral belly fringe and the single, elongate, temporal spine on each side will identify this species and separate it from all other United States horned lizards. Also characteristic are the exposed tympanum, the absence of enlarged gular scales, the femoral pores invading the preanal region, the spotted belly, and the large chinshields.

Habitat. This is the most common and widespread of the western desert horned lizards. They are found generally in valleys or flat areas up to an

elevation of 6500 feet. Sandy or gravelly soil is preferred. The habitat may be among scattered rocks or in regions of low vegetation. They do not occur on open desert where there is no cover in the form of rocks or plants.

Habits. Where rocks occur, these lizards can be seen in abundance sunning themselves on them, at temperatures that feel uncomfortable to humans. When approached at such times, Klauber observed that they ducked their heads as if to dodge a blow, but did not attempt to run. Where bushes form the cover, they usually run under them when disturbed while basking or foraging away from their protection, and frequently allow themselves to be

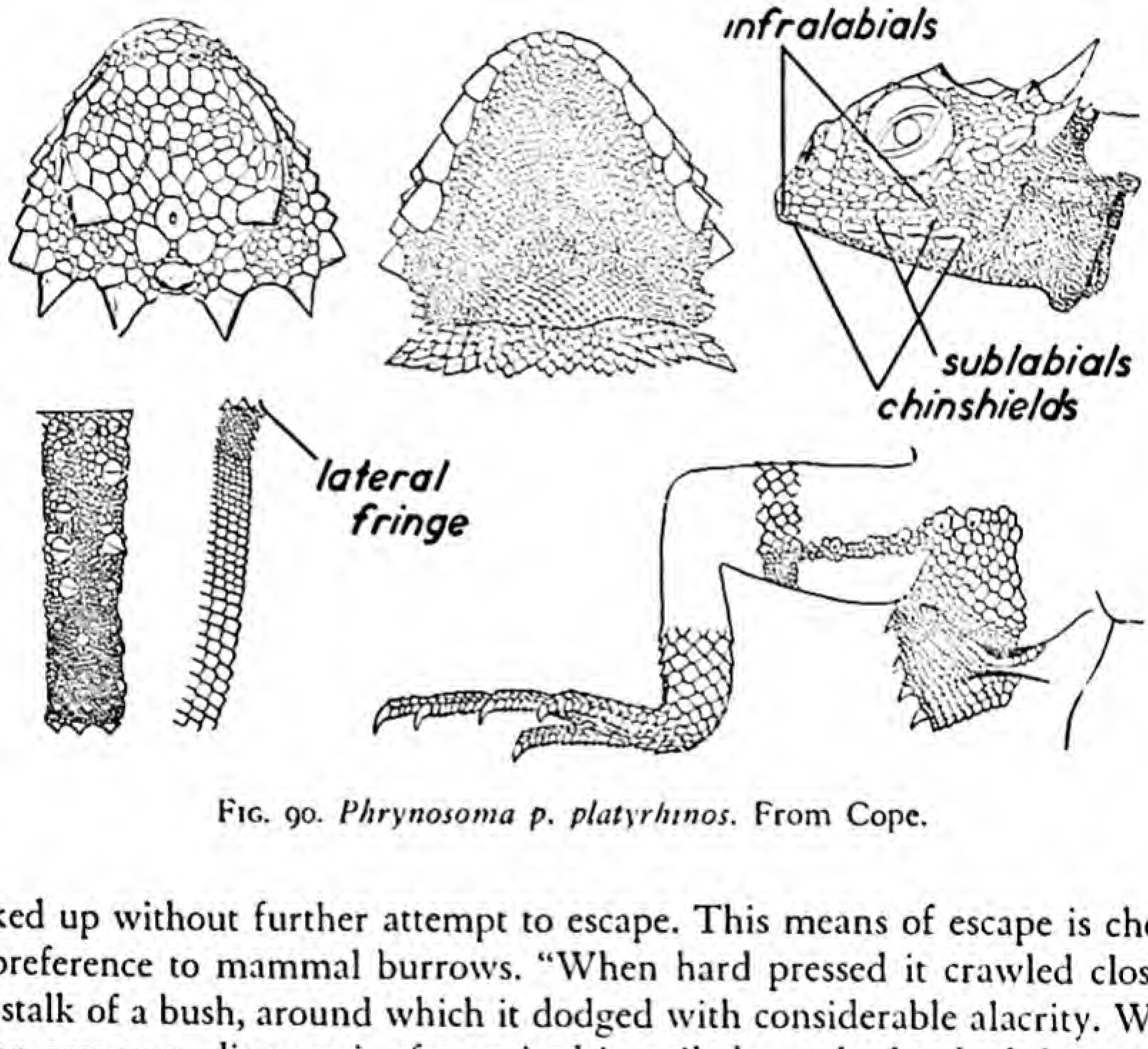


Fig. 90. *Phrynosoma p. platyrhinos.* From Cope.

picked up without further attempt to escape. This means of escape is chosen in preference to mammal burrows. "When hard pressed it crawled close to the stalk of a bush, around which it dodged with considerable alacrity. When it ran any great distance it often raised its tail above the level of the sand in a manner suggestive of the more agile *Callisaurus*" (Richardson). In some areas the species finds cover, scant though it may be, under Russian thistle. When picked up they may "play possum," keeping the legs close to the body and not moving. Upon being picked up they may open their mouths and hiss slightly.

Activity continues during a large part of the day. Specimens have been observed sunning themselves as early as 5:00 A.M., and others are active as late as half an hour after sunset. At night they seek underground protection; it is probable that they fashion their own retreats by scooping the sand away laterally until only the head remains near or at the surface.

Shedding specimens have been observed on July 3.

The food consists largely of ants, but other arthropods, particularly beetles, are taken occasionally. Parasitic roundworms frequently occur in their stomachs.

Mating has been observed June 10, but no doubt generally occurs earlier. The eggs number 9 to 13 and are laid sometime after the middle of June. Young hatchlings have been observed on July 31. Hibernation begins early in November and continues until about the first of March.

The trait of squirting blood from the eye, common to many horned lizards, has not been observed in this species.

Color change is dependent primarily upon temperature, secondarily upon illumination and other factors. At high temperatures (about 100° F.) the light phase is assumed, and at low temperatures the dark phase occurs. At moderate temperatures, however, the presence of light induces the dark phase, of darkness the light phase.

> The production of the change of phases in response to presence or absence of illumination can be carried out for a long time without signs of fatigue in the animal's mechanism. . . . Darkening can usually be seen in one minute's time. Of course, complete change requires a longer interval, ten to fifteen minutes or more. Even in an hour's time the complete change may not have occurred if the temperature is relatively low (Atsatt).

Problems. The range of this form is not well known in the north, nor has the life history been well studied.

References. Atsatt, 1939, pp. 260–262, fig. 8, color change (*lit. cit.*); Klauber, 1939, pp. 33, 69, 73, 75, 80, 83, 94, table 15, habits, habitat (*Ariz.*); Linsdale, 1938, p. 28, habitat (*Nev.*); *idem,* 1940, pp. 232–235, fig. 16, Nevada records, habits, habitat (*Nev.*); Richardson, 1915, pp. 422–423, habits, food, eggs (*Nev.*); Stuart, 1932, p. 30, habitat (*Utah*); Taylor, 1912, pp. 351–352, habits, habitat, eggs (*Nev.*); Van Denburgh, 1922, pp. 421–426, pl. 36, synonymy, description, variation, range, localities, habits (*gen. lit.*).

For detailed notes on food, see Knowlton, 1934, pp. 1002–1003; Knowlton and Janes, 1932, p. 470; *idem,* 1933, p. 1015; *idem,* 1934, pp. 12–13, fig. C; Knowlton and Thomas, 1934, p. 259; *idem,* 1934, p. 264; *idem,* 1936, p. 65 (all *lit. cit.*).

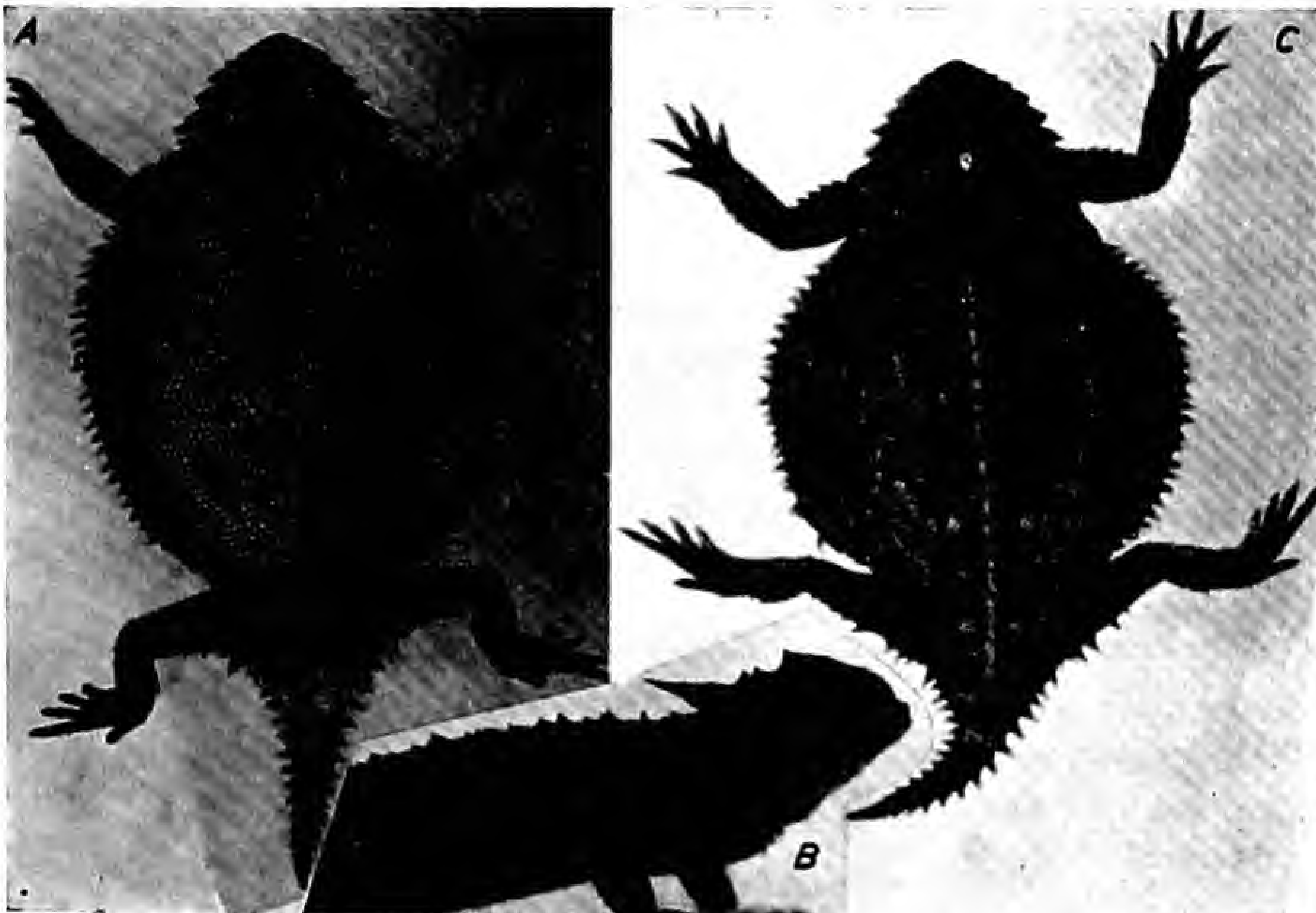
Regal Horned Lizard *Phrynosoma solare* Gray

(Fig. 85, p. 288; Pl. 86)

Range. The southwestern corner of Arizona, central and western Sonora, and extreme northeastern Baja California. Type locality—"California," by error, since the species is not known from that state. (Map 22, p. 498.)

Size. A rather large species, reaching a maximum snout-vent length of a little more than 100 mm., the largest recorded specimen measuring 103 mm. (4½ in.). The tail is about ½ the head-body length.

Color. The median dorsal ground color in a broad, oval area is pale gray to yellow or reddish gray; the sides are distinctly darker. There may be a median white line or not. Three dark undulate crossbands or spots may be present on either side of the median line of the back; they may be fused with spots in a similar lateral series, or with each other, producing longitudinal dark bands. There is a dark area on each side of the neck, more or less merging with the color of the sides of the body. Although the dark paravertebral spots may be bordered posteriorly by light areas, none of the dark



Pl. 86. *Phrynosoma solare.* A, C, Tucson, Arizona; female. B, Santa Rita Mountains, Arizona; male.

markings above mentioned are sharply defined. The limbs may have vague dark marks. The head is yellowish, stippled or clouded (or both) with dark brown. The tail has narrow, dark crossbars. The keels on the paravertebral tubercles are brown. The ventral surfaces of chin, belly, preanal region, and hind legs have small, scattered, black or dark brown spots.

Scalation. See Fig. 85. The unique feature in the scutellation of this species of horned lizard is the presence of two occipital horns on each side instead of the usual one. There are 4 temporal spines, decreasing in size anteriorly, not reaching lip, forming a practically continuous series with the occipital horns and thus forming a semblance of a "crown," on which the name is based. The nostrils are distinctly within the canthi. A series of enlarged chinshields increasing in size posteriorly, reach the rictus oris. A single longitudinal

series of enlarged throat scales on each side; a transverse series of enlarged scales immediately preceding chest; 2 groups of enlarged tubercles on sides of neck. A single series of enlarged lateral abdominal scales; scattered enlarged scales on back, strongly keeled, pointed, arranged in irregular longitudinal series, those nearer median line largest. Femoral pores 14 to 26; enlarged postanals usually present in males.

Recognition Characters. There is no other horned lizard in the United States with 4 occipital horns.

Habitat. This species is characteristic of greasewood and mesquite associations of plains and mountain valleys. They may occur at considerable elevations, however, as Ortenburger found one "near the highest point on the road between Oracle and Mammoth."

Habits. "In the mesquite association these lizards are most frequently found lying quietly on the ground under a clump of nopal (*Opuntia* sp.); if disturbed upon the open sand they run to the nopal clumps if at all possible" (Ortenburger). Like other horned lizards, these strongly tilt the body; when one side is scratched the other will tilt as high as the legs can lift it, while the opposite is depressed to the ground. This tilting proclivity is put to good use in late evenings, when it is said that these lizards incline themselves toward the setting sun in order to receive the full benefit of its rays.

Gloyd records finding one near an ant nest that had eaten quantities of these insects.

Problems. An analysis of the variation in this species may possibly reveal two or more geographic races; Sonoran specimens seem a little different, and Ortenburger comments that the one taken at high elevation in the Santa Catalinas also was unusual in character. The natural history is practically unknown.

References. Gloyd, 1937, p. 113 (*Ariz.*); Ortenburger, 1926, p. 108 (*Ariz.*); Van Denburgh, 1922, pp. 406–409, pl. 34 (*gen. lit.*).

The Poreless Utiform Section

Only one other group of the iguanids of North America lacks pores; that group is the leaf-toed section, including *Anolis*. In Central and South America there are still other sections of the family that lack pores; in fact by far the largest part of South American iguanids lacks pores, contrary to the situation in North America. The single genus, *Leiocephalus,* here treated in the poreless utiform section, is included only because of the importation of a single form from the Bahamas, and its establishment, at least temporarily, near Miami. The section is not a normal, endemic part of the United States lizard fauna.

The section is widely distributed in the West Indies and western South

America, where it is represented by a number of genera. The exact number is not known since the South and Central American genera of the family have never been segregated into groups to show relationship and phylogeny. About four or five genera appear to belong to this section.

The Crested Keeled Lizards

Genus *LEIOCEPHALUS* Gray

This is a large tropical genus distributed rather widely in western South America and in the West Indies. It is included here on the basis of specimens imported from the Bahama Islands and released near Miami, Florida, where they have apparently established themselves in the new environment.

The genus is related to *Sceloporus*, although the relationship is not extremely close. The general form is rather similiar, however, and indicates a similarity of habits.

The species occurring in the United States is oviparous.

Bahaman Crested Lizard *Leiocephalus carinatus virescens* Stejneger

Range. Green Cay, Bahama Islands; introduced into region about Miami, Florida. Type locality—Green Cay, Bahamas.

Size. An adult measures 87 mm. (3½ in.) snout to vent; the tail is about 1⅓ times as long as the head and body. The limbs are stout, the body much like that of the fence lizards.

Color. Gray or brownish above. Some of the vertebral scales dark-edged; a narrow light area borders this, and then a broken dark streak or a series of small dark spots extends from neck to tail. The sides of the neck and body may be a little darker. There are a number of narrow dark bands in the tail, more distinct distally. On the head are a number of irregular, dark brown streaks and flecks.

The throat has rather large, irregular, scattered, dark spots, sometimes very dim; they occasionally extend onto the chest, where they become smaller and less distinct. The belly is immaculate or with vague, dark flecks. The subcaudal surface shows some evidence of the dorsal dark rings, especially toward the tip.

Scalation. Scales rather large, keeled, pointed, about 51 to 55 from occiput to base of tail; dorsal scales in slightly converging rows; vertebral row continuous, composed of slightly enlarged, heavily keeled scales; on tail this row is more prominent, serrate; the tail is also slightly flattened laterally.

Head scales enlarged, convex; 5 to 7 large supraoculars; a very narrow,

elongate occipital bordered by a pair of elongate parietals in turn bordered by a pair of very large, rounded parietals; frontal divided into 4 scales; lorilabials not continuous around snout behind rostral; nasal in contact with rostral; prefrontals, frontonasals, and internasals irregular; an elongate subocular, in contact with supralabials.

Recognition Characters. The spinose, rather large, dorsal scales, and the absence of the femoral pores characterize this species and will separate it from any other occurring in Florida. The very narrow occipital, the 2 parietals on each side, the four frontals, the nasal in contact with rostral, the absence of postrostrals, and the enlarged vertebral scales (especially on tail) are also distinctive characters.

Remarks. This form was first recorded from the United States by Barbour, who remarked concerning it, "I confess that the presence of this race in the outskirts of North Miami puzzled me completely, until it occurred to me that last year at Opalocka Zoo I saw several cages full of *Leiocephali* which someone had brought back from some of the smaller Bahama islands." The basis for the record was one of "two lizards which had been found by some of the students of Mrs. Palmer, teacher of Biology in the Edison High School in North Miami." Little more is known of the existence of the species in this country. Carr in 1940 stated, "I know little of this introduced Bahamian form beyond Barbour's remarks (1936) concerning its occurrences in the Miami area. Frank N. Young recently saw two specimens in a pet shop in Miami; these specimens, one of which laid an egg after its capture, were said by the proprietor of the shop to have been taken in Miami."

References. Barbour, 1936, p. 113, as quoted above (*Fla.*); Carr, 1940, p. 72, as quoted (*Fla.*); Stejneger, 1900, p. 471, brief description (*lit. cit.*).

The Plate-bellied Night Lizards

Family XANTUSIIDAE

This is a small family of only four genera and but few species. The largest genus, in number of species, is our own *Xantusia*. The family occurs from southwestern United States to Panama and in Cuba. All species are small, the largest having a snout-vent length of not over 6 inches.

The family has peculiar characters, and the lizards are as peculiar in habits. The pupils are vertical and there are no eyelids; the belly is provided with rectangular plates, and the dorsal surface is granular, with or without scattered, enlarged tubercles; there are no osteoderms; large, regular plates are on the head; femoral pores are present; and the young are born. All the species are secretive and nocturnal, and several are rather rare.

The Night Lizards

Genus *XANTUSIA* Baird

Five species are recognized in this genus, restricted to southern California, Arizona, Baja California, and adjacent islands. One of the species was only rather recently (1931) discovered and described, from Arizona. Only one species is extralimital—*gilberti* of the Cape region of Baja California. All were at one time considered very rare, but with the development of better collecting methods at least those of the United States have become common in collections. The most successful single collecting method is that of looking for and removing thin flakes loosened from the faces of granite boulders. These form on granite rocks as a result of the rapid and considerable changes in temperature that accompany desert conditions, and under them night lizards as well as other animals find protection. So characteristic are these lizards of granite boulders with exfoliated flakes that wherever one finds the condition one expects *Xantusia*.

Some details of the scutellation of a typical species are shown in Fig. 91.

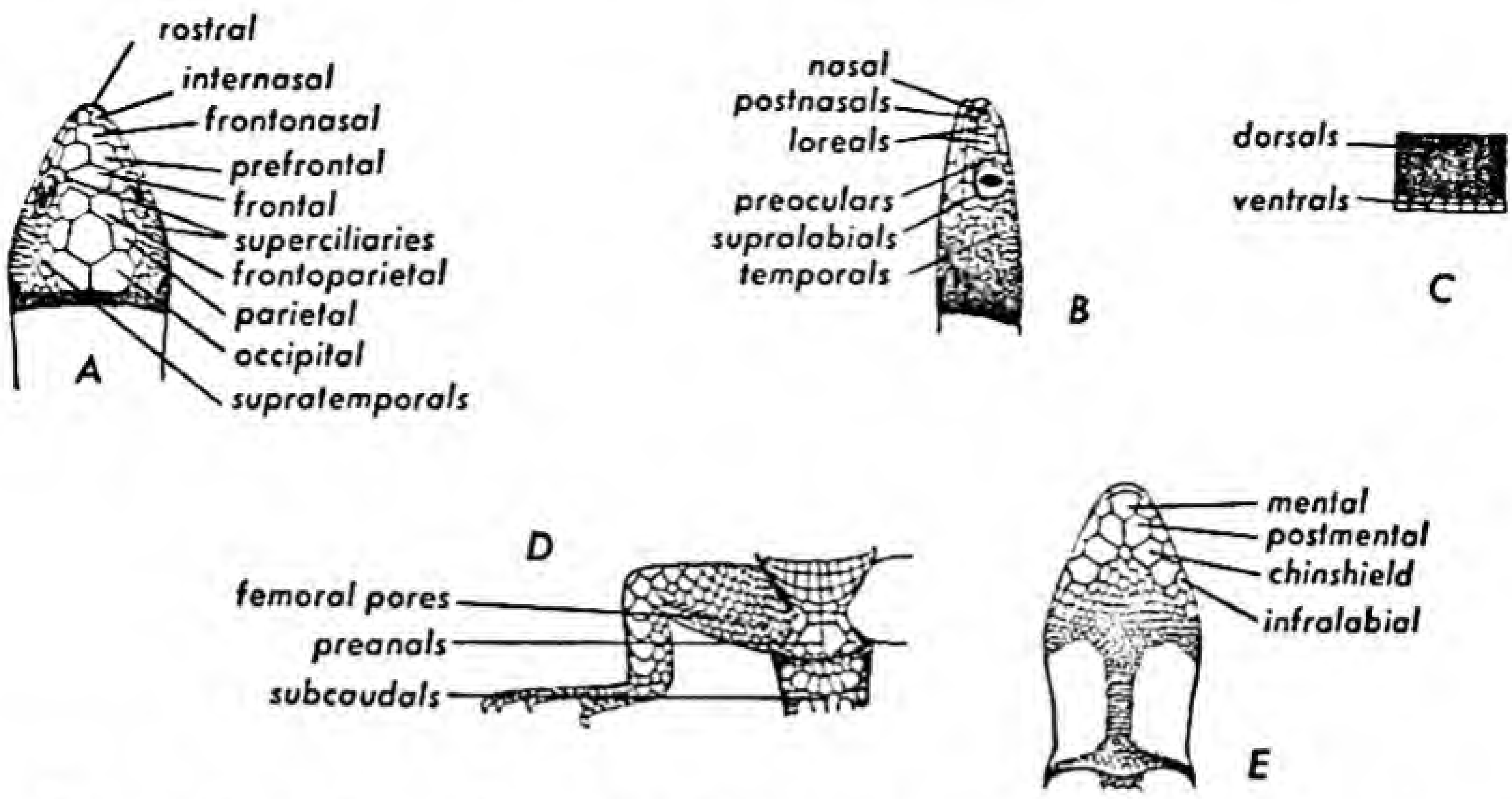


FIG. 91. Typical scutellation in *Xantusia,* from *X. henshawi,* Tejon Pass, California. A, top of head; B, side of head; C, section of side of body; D, ventral view of right hind leg and anal region; E, underside of head. From Cope.

KEY TO SPECIES OF *XANTUSIA*

1. Ventral plates in 16 longitudinal series at middle of belly; 2 series of small plates (superciliaries and supraoculars) over eye (Fig. 92) .... *riversiana* (p. 327)
   Ventral plates in 12 or 14 longitudinal series; one series of plates (superciliaries) over eye (Fig. 91A) 2

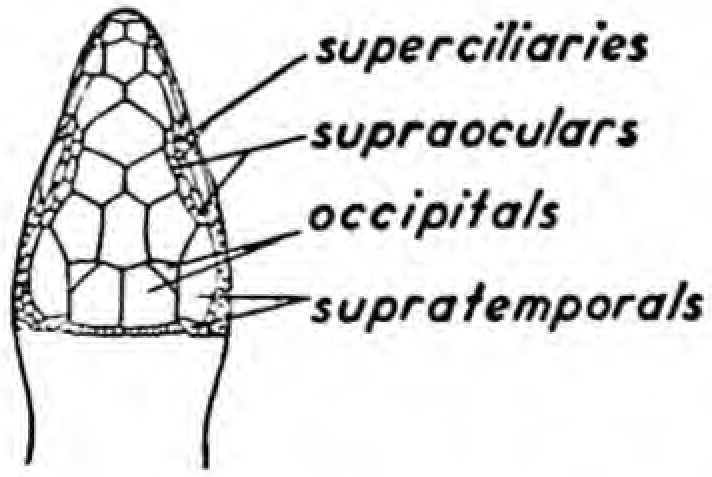


FIG. 92. *Xantusia riversiana*, top of head. From Cope.

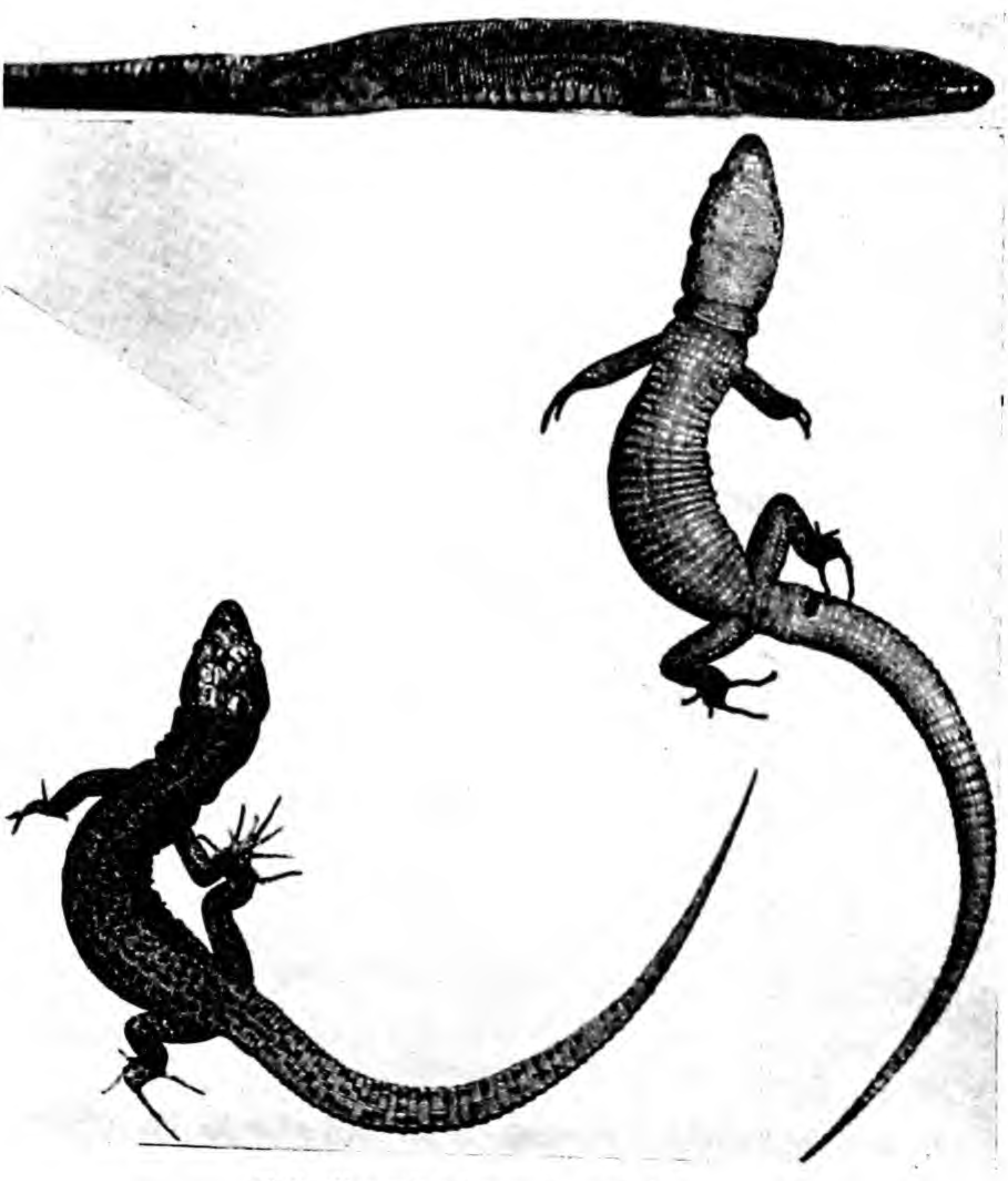
2. Ventral plates in 14 series; dark spots very large, separated from each other by narrow light areas .... *henshawi* (p. 325)
   Ventral plates in 12 rows; dark spots small, occupying much less space than light areas 3
3. Dorsal granules across middle of back 43 to 50; lamellae under fourth toe 25 to 26 .... *arizonae* (p. 323)
   Dorsal granular scales 33 to 40 across middle of back; lamellae under fourth toe 18 to 20 .... *vigilis* (p. 330)

Arizona Night Lizard *Xantusia arizonae* Klauber

(Pl. 87)

Range. Central and western central Arizona. Type locality—Weaver Mountains, 1 mile south of Yarnell, Yavapai County, Arizona. Recorded elsewhere only from Valentine, Mohave County; McCloud Mountains, 3 miles north of Hillside, Yavapai County; Superstition Mountain, 5 miles northeast of Apache Junction, Pinal County. (Map 24, p. 499.)

Size. A rather small species, with a snout-vent measurement reaching a



Pl. 87. *Xantusia arizonae.* Yarnell, Arizona.

maximum at about 54 mm. (2⅛ in.); the tail is about 1⅒ (probably to about 1⅓) times the head-body measurement.

Color. Dorsal surface light gray to yellowish gray, spotted with small, oval or somewhat elongate, black dots arranged more or less in longitudinal rows, 7 in number. Limbs and tail with similar, scattered, dark spots. A dark line through eye, extending from snout onto sides of neck. Ventral surfaces immaculate, cream or white.

Scalation. As in *vigilis,* with 12 longitudinal rows of ventrals at middle of belly, 1 row of superciliaries, etc., except that granular scales across back number 43 to 50; lamellae on fourth toe 25 to 26. Limbs a little longer, more than about 40 per cent the snout-vent length in adults.

Recognition Characters. This species is easily distinguishable from all others in the United States except *vigilis* (see discussion of latter). There are a number of differences between these two, however, the most conspicuous of which are the less numerous dorsals in a transverse row (33 to 40) and the less numerous lamellae under the fourth toe (18 to 20) in *vigilis.*

Habitat. Found on hillsides among large granite boulders interspersed with heavy chaparral.

Habits. These lizards are best collected by turning over the thin outer flakes on the boulders or prying loose the heavier slabs on the sides. Whether they will be found under heavy slabs or thin flakes depends perhaps upon the season; during the middle of summer they seek deeper crevices on shady sides to avoid the extreme heat; but when the heat is more desired in spring and autumn, they are more frequently found under thin flakes. The lizards were found under larger slabs in late August; in late May Gloyd reports, "Most of them were beneath flakes of medium size and at least two or three inches thick situated on or near the tops of the boulders. About one out of every five slabs sheltered a lizard and never was more than one found in the same place." Over a period of several days Gloyd and his group secured 27 specimens.

Klauber believes

arizonae is somewhat easier to catch than *henshawi,* for it does not move so quickly when uncovered. As is the case with the latter it clings to the parent boulder and not to the slab pried off. It bites if not caught by the head. It curls around the finger as does *henshawi* and, in addition, twists laterally, a motion which the California form does not have. When uncovered, *arizonae* does not change color conspicuously as does *henshawi,* but seems to become slightly lighter in ground color.

From the specimens taken it is evident that this species is ovoviviparous, giving birth to one or two young alive about September 1st.

The food contained in two stomachs consisted of a few weevils and other beetles, ants, and bugs.

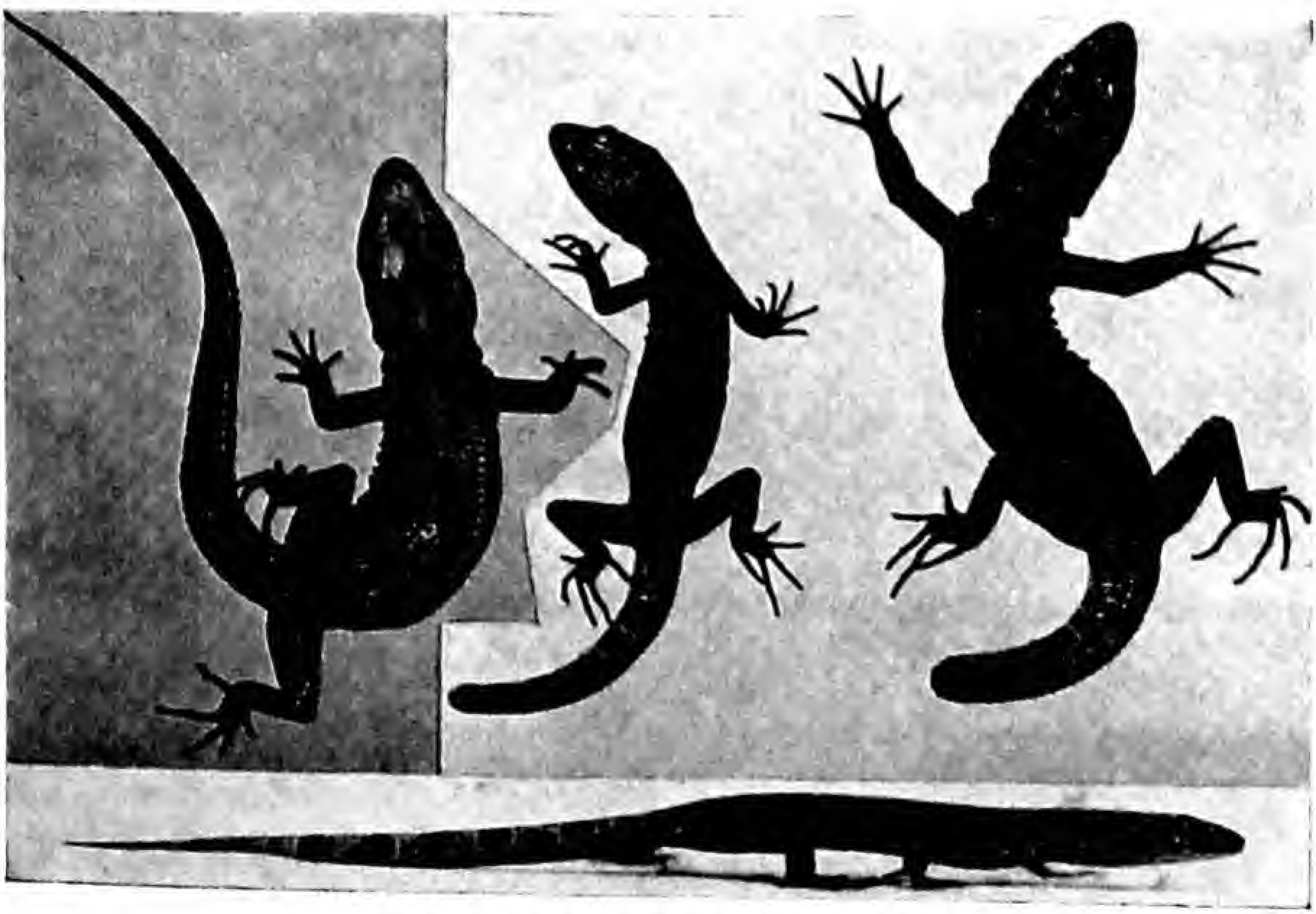
Problems. The distribution of this species is not well known, as it is found rather widely in Arizona (over a distance of 200 miles), but it is known essentially from only three localities. The natural history is incompletely known.

References. Gloyd, 1937, p. 22 (*Ariz.*); Klauber, 1931, pp. 1–14, pl. 1, description, habits, habitat (*gen. lit.*).

Granite Night Lizard *Xantusia henshawi* Stejneger

(Fig. 91, p. 322; Pl. 88)

Range. Rocky areas on both slopes of the mountains from southern Riverside County, California, to the San Pedro Mártir Mountains of northern Baja California (Klauber). Type locality—Witch Creek, San Diego County, California. (Map 24, p. 499.)



Pl. 88. *Xantusia henshawi.* Jamacho, California.

Size. Maximum snout-vent measurement recorded is 68 mm. (2$^{11}/_{16}$ in.); the tail is from 1$\frac{1}{10}$ to 1$\frac{1}{3}$ times the head-body length. The limbs are well developed, the head, body, and tail greatly flattened.

Color. Ground color pale yellowish brown. Numerous large, rounded, well-defined, very dark brown spots of varying shape and size scattered over back and sides; spaces between these spots sometimes clouded with brown. Head a uniform light yellow-brown, or all the scales dark brown, with light edges;

limbs mottled or spotted; tail with very irregular, narrow, dark rings. Entire ventral surfaces cream, unmarked.

Scalation. See Fig. 91. Dorsal scales small, equal, granular; ventral scales enlarged, flat, juxtaposed, square or quadrangular, in 14 longitudinal series at middle of belly; a granular gular fold, preceded by some enlarged scales. Two scales immediately preceding anus notably larger than others. One row of superciliary scales. Eight to 10 femoral pores on each side. No enlarged postanals. Ear opening prominent. No eyelids. Pupil vertical except in darkness.

Recognition Characters. The genus to which these peculiar lizards belong can be distinguished from all others in the United States by the presence of well-developed legs, ear openings, and large head scales, and the absence of eyelids. From the other three United States species *henshawi* may be distinguished by its peculiar pattern of large dark spots and the 14 longitudinal belly scale rows. There are of course other differences, but these are perhaps the most striking. Contrary to *arizonae* and *vigilis*, which have a black peritoneum, the inner abdominal membrane in this is light in color. The significance of this difference is not known.

Habitat. These are confined almost exclusively to granite boulders, from 450 to 4500 feet above sea level (to 7300 feet in Baja California).

Habits. As recently as 1922 these lizards were considered rare and very difficult to capture. In that year Van Denburgh said they could be hunted successfully during only 15 or 20 minutes each day, just at dusk as they emerged from their crevices. But in 1923 the same author and that peer of western collectors, J. R. Slevin, discovered how they could be found in abundance at any time. Klauber developed and used this method with great success for the next few years and in 1926 wrote,

> In capturing these lizards the collector searches amongst granite boulders for loose flakes partially separated from the parent rock. These are pried off by means of a pinch bar or other suitable tool and if a lizard is found beneath he is quickly covered with a hand while still light struck. The fingers are then worked around to the head and the game is bagged. Care must be taken not to hold the tail or it will be dropped.
>
> The operator must so place himself before the flake that he will not lose his balance (nor be beneath) when it falls; otherwise he cannot use the requisite speed and his quarry escapes. Dodging the falling flake, which may weigh from a few pounds to several hundred, and avoiding the scorpions and centipedes while covering the lizards, lends interest to the hunt. . . .
>
> I have taken specimens in every month from February to October inclusive. They are most plentiful in April and May. At such times they are discovered under the thinnest surface flakes, usually on the south and west sides of the boulders where the sun's warmth is most evident. On the other hand after the summer heat in the district back from the coast has become oppressive they are more difficult to locate and are usually under the thicker slabs and on the shady side. It is probable that at such times the majority are deep in the inaccessible crevices between the boulders.

The likeliest flakes in the spring months are those which are thin and well up the sides of the boulders. They vary in area from a few square inches to many square feet. If they are sufficiently raised from the boulder surface to insert a pinch bar tip, then there is room for one of these exceedingly flat lizards. The vertical flakes are more likely hiding places than the horizontal which rest on the boulder tops. The rock walls must be clean; if soil has been deposited in the crevice it will be found to be untenanted. The lizards can rarely be seen before the flake has been pried off and it is not remarkable that they were scarce before the pinch bar was used. Where flakes are of good quality about one in ten should yield a specimen and about half of those seen can be caught. If two persons cooperate, one wielding the bar while the other watches the lizards, nearly all can be secured. They do not usually congregate together, but I have found as many as five under a single large flake. . . .

The species is ovoviviparous, as proved by a specimen taken September 3 which contained two well developed embryos. The young seemed more numerous under the flakes in the late fall and early spring.

Interesting color changes may be noted in the field. Immediately upon being uncovered the lizards are almost entirely black or dark olive green with a thin tracery of yellow lines. The tails are dark with wider white lines. After exposure the lighter lines, originally thin and thread like, spread so as to cover a considerable portion of the total area, leaving the original dark portions as isolated spots.

Atsatt's investigations on color changes and their causes show a reverse of the usual trend in lizards in response to high temperatures: the dark phase is induced by high temperature. The light phase may or may not accompany low temperature, according to other conditions not well known. A daily rhythm of change—dark during the day, light at night—is more or less fixed. Extraordinary excitement may induce the light phase although the temperature may be high.

The food is not known. Klauber (1939) reports a specimen that had choked to death on a grub. Mites are found on some specimens.

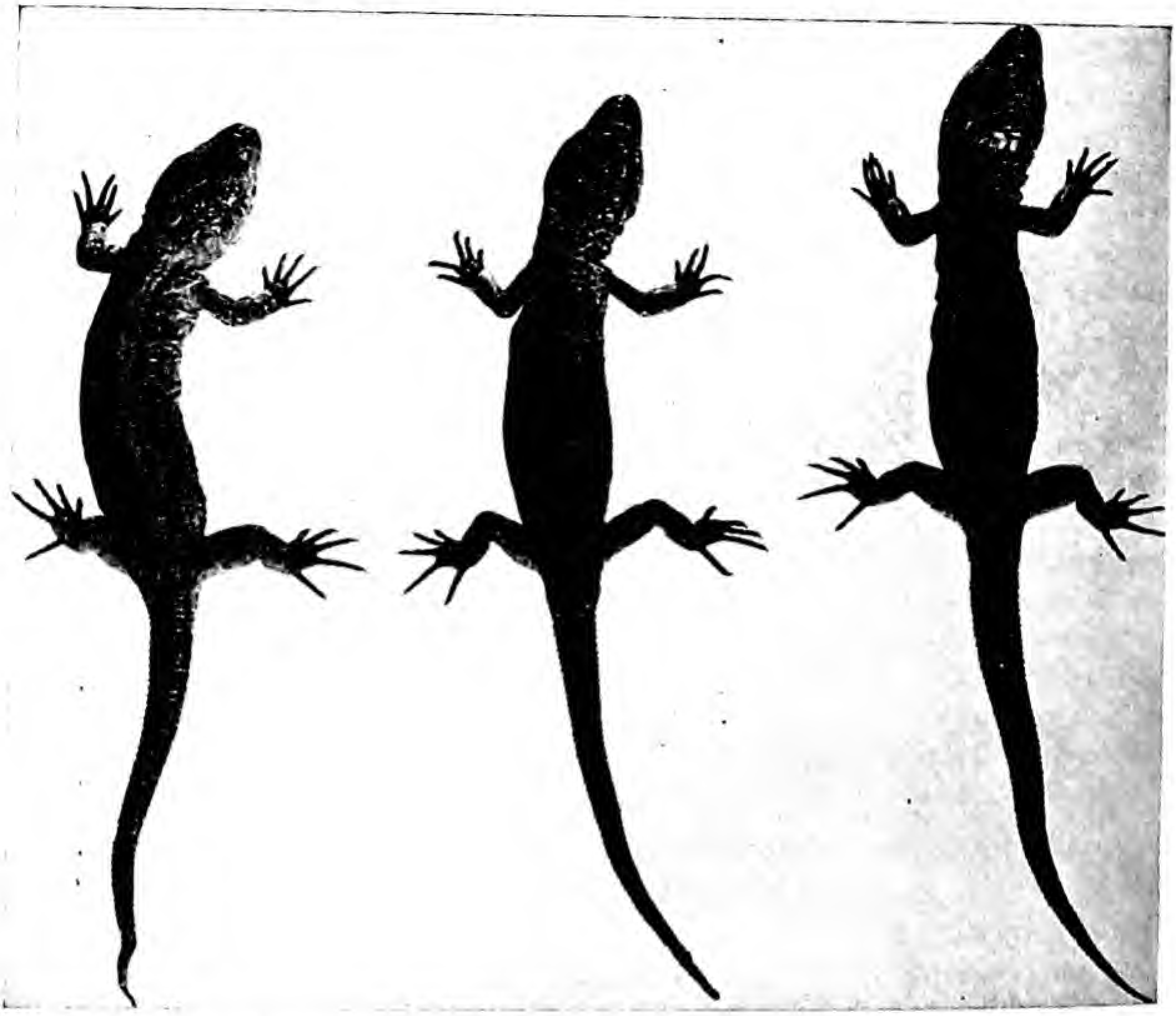
Klauber (1939) notes that, owing to the ability of these lizards to seek refuge in deep cracks, they can survive the burning over of territories where they occur more successfully than the less secretive but usually more abundant lizards such as *Sceloporus* and *Uta*, which are generally nearly exterminated in the burned-over areas.

References. Atsatt, 1939, pp. 262–264, fig. 9, color change (*lit. cit.*); Klauber, 1926, pp. 115–117, range, localities, habits, habitat (*lit. cit.*); *idem*, 1939, pp. 33, 74, 76, 83, 96, 97, 98, table 15, habits, localities (*Ariz.*); Van Denburgh 1922, pp. 484–486, pl. 50, description, range, localities (*gen. lit.*).

Island Night Lizard *Xantusia riversiana* Cope

(Fig. 7, p. 61; Fig. 8, p. 62; Fig. 92, p. 322; Pls. 89–90)

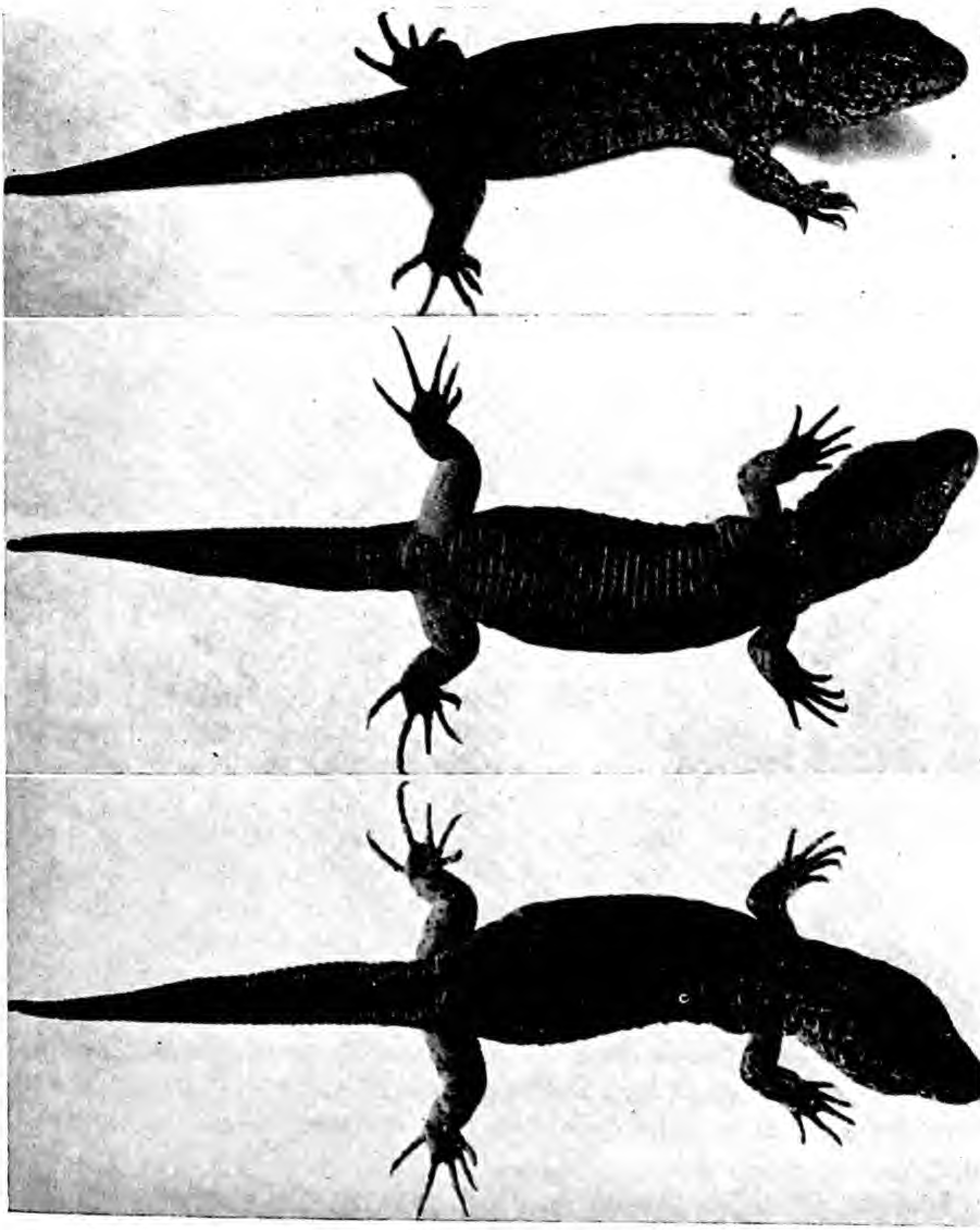
Range. San Nicolas, San Clemente, and Santa Barbara Islands, off southern California. Type locality—San Nicolas Island. (Map 24, p. 499.)



Pl. 89. *Xantusia riversiana.* San Nicolas Island, California. U.S. Fish and Wildlife Service photograph.

Size. The largest member of the genus, reaching 106 mm. (4³⁄₁₆ in.) snout to vent; the tail measures a little less than the head and body.

Color. Ground color smoke gray or cinnamon; in the lightest specimens there are a number of rather well-dispersed, scattered, dark brown dots on the dorsal and lateral surfaces. In darker specimens there is a coarse reticulation of dark brown on the back; there is a great deal of variation in the markings; in some there may be even a pair of longitudinal, dorsolateral, black lines extending the length of the body, originating at the corner of the head above the ear opening, and extending upon the tail. In the last variant the median space between the lines is unmarked. Even in mottled specimens, however, a broken, irregular, dark, dorsolateral stripe may be present on the tail, bordered above by a light stripe, between the two of which is enclosed a mottled area. In other specimens the tail is irregularly mottled. The head is mottled and spotted, or nearly a uniform cinnamon. The ventral surfaces are white, except for a few black flecks on the sides of the belly, under the tail, and toward the sides of the throat.



Pl. 90. *Xantusia riversiana.* San Clemente Island, California. U.S. Fish and Wildlife Service photograph.

Scalation. Dorsal scales small, granular; ventral scales in 16 rows across middle of belly, square, flat, enlarged; a granular gular fold, bordered anteriorly by enlarged scales. Preanal scales irregular, usually with more than 2 in the second row, the first pair largest. Two rows of superciliary scales (Fig. 92). Five to 12 femoral pores on each side. Ear opening prominent. No eyelids. Pupil vertical except in darkness.

Recognition Characters. The 2 rows of superciliaries distinguish this species from all others of the genus; equally distinctive are the 16 rows of belly scales.

Habits and Habitat. "This species usually is found under stones and pieces of wood. It probably is more or less nocturnal in its habits, but Mr. Slevin and I observed it actively hunting in bright sunlight on San Nicolas Island" (Van Denburgh).

Problems. The natural history of this species is practically unknown.

Reference. Van Denburgh, 1922, pp. 486–489, pl. 51, description, variation (*gen. lit.*).

Desert Night Lizard *Xantusia vigilis* Baird

(Fig. 9, p. 62; Pl. 91)

Range. Southern Nevada, extreme southwestern Utah, and northwestern Arizona west to eastern Los Angeles County, north to northern Inyo County, and southward through central southern California to northeastern Baja California. Type locality—Fort Tejon, California. The species has been introduced into Santa Catalina Island. (Map 24, p. 499.)

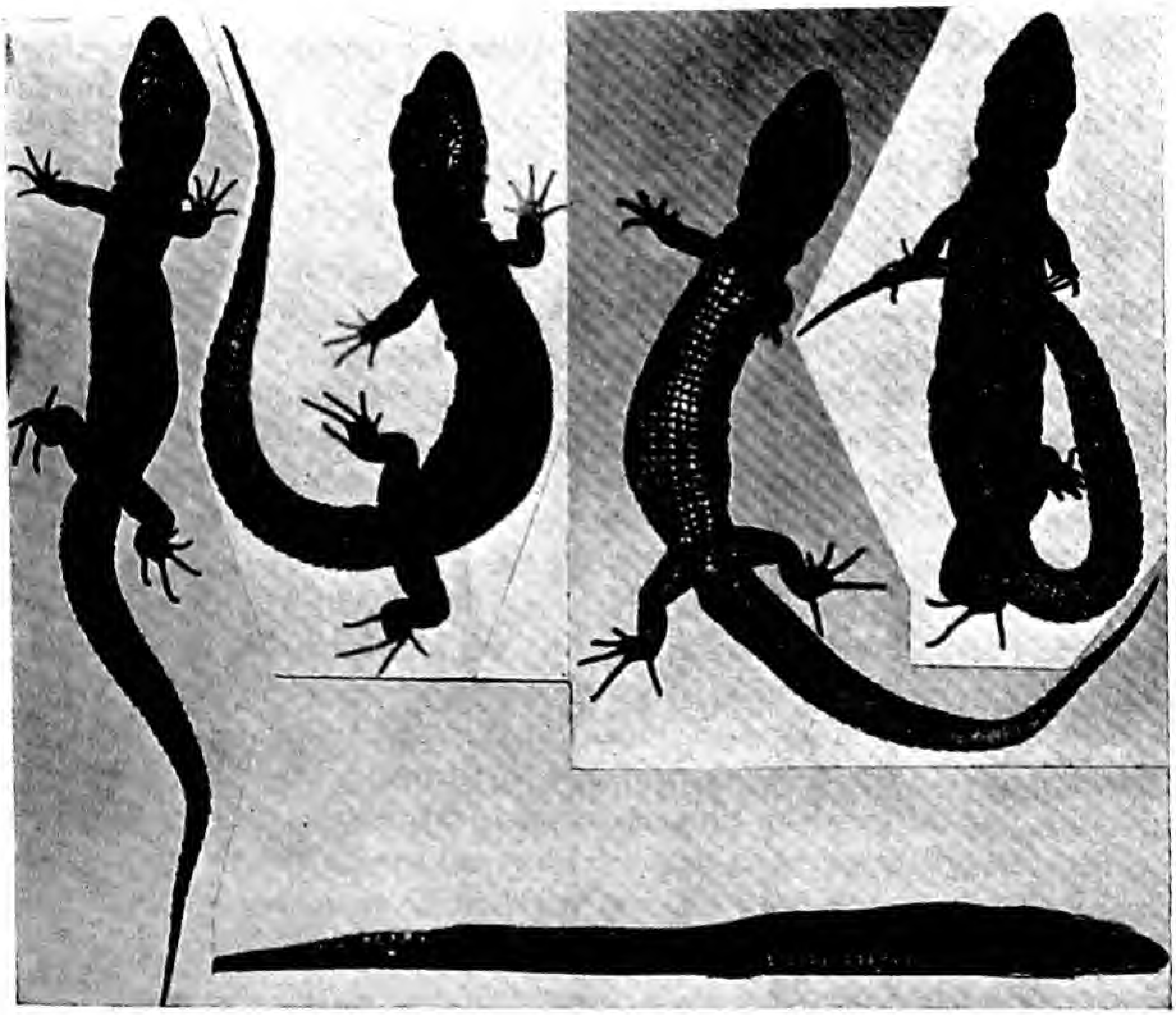
Size. A small species, maximum snout-vent measurement about 47 mm. (1⅞ in.); the tail is slightly longer than the head and body to nearly 1½ times as long. Head and body not notably flattened. Newly born young 47 to 51 mm. in total length.

Color. Dorsal ground color light cream to clove brown; numerous small, very dark brown or black spots, usually confluent with each other in such a way as to form short longitudinal lines. Some specimens may show scarcely any markings, and others are heavily marked. Usually visible is a narrow light line extending from the posterior superciliary region onto the neck. Scattered dark spots are present on the limbs and tail. The sides of the gular region may be mottled or otherwise pigmented. The sides of the belly may also be feebly mottled. Otherwise ventral surfaces white, with a fine, scattered stippling not visible to the naked eye, more concentrated on the subcaudal surface.

Scalation. Dorsal scales small, equal, granular; ventral scales enlarged, flat, juxtaposed, square or quadrangular, in 12 longitudinal series at middle of belly; a granular gular fold, preceded by some enlarged scales. Usually 4 subequal preanal scales, one pair preceding the other. One row of superciliary scales. Six to 10 femoral pores on each side. No enlarged postanals in males. Ear opening prominent. No eyelids. Pupil vertical except in darkness. Granular scales across back 33 to 40; lamellae on fourth toe 18 to 20. Limbs about 36 per cent of snout-vent length in adults.

Recognition Characters. This species can be known, and distinguished from all others in the United States, except *arizonae*, by the absence of eyelids, the

presence of limbs, a distinct ear opening, and 12 rows of large, quadrangular, belly scales. The reticulated pattern is characteristic of both this and *arizonae,* as are the 12 ventral scale rows; these two characters will distinguish these two species from all others of the genus. For a comparison with *arizonae,* see the discussion of the latter.



Pl. 91. *Xantusia vigilis.* Lovejoy Springs, Antelope Valley, Los Angeles County, California.

Habitat. The highest elevation at which this species has been found is 5200 feet, at Walker Pass. It is found in semiarid flats and occurs in greatest abundance under fallen and rotting Joshua tree trunks; it also is found under Spanish dagger, under boards, cardboard, in holes or burrows under bushes, and rarely under flakes on granite boulders. Where Joshua trees and Spanish dagger occur together, the latter appears to be preferred.

Habits. Klauber (1939) recommends the "old fashioned hayhook" to overturn the fallen trunks of Spanish dagger and Joshua trees in search for these lizards, because the sharply pointed leaves are very painful to the hands.

The hunter should be set to grab the quarry before overturning the stem; for the lizards, although light-struck at first, quickly wiggle under other stems or

debris. A handful of soft muslin in one hand, as the other wields the hook, is excellent for covering and pinioning the prey. Once a lizard is held down with the soft pad, it is easy to roll it back slowly until the head or a leg is disclosed, thus permitting a capture without breakage of the fragile tail. . . . It is best not to hunt *X. vigilis* when it is too warm, for they will then be very active and difficult to catch when uncovered. In cool weather they are more torpid, and when light-struck, will give the hunter a better chance to secure them. We have made good catches as early as February and March. They should not be hunted at dusk, as they will not be light-struck and will run at once. . . . Well rotted debris, adhering closely to the ground, is more often found to harbor lizards than recently fallen branches or stems. . . . The tails . . . are broken off at the slightest touch; they squirm with great violence for some moments when disjointed.

When uncovered and recovered from the first shock, their immediate action is to find shelter. They do not enter burrows or other holes but seek to hide under, or to climb, something; in their haste they do not select their cover carefully but may even climb the person of the collector. When frightened, at least at moderate temperatures, they become very light in color in but a very few moments. In darkness they become dark. The young change color more slowly than the adults. Normal excitement in the morning does not cause paling, but it does in the evening. The diurnal color is normally dark, nocturnally pale. High temperatures, under experimental conditions, produce a darkening; a paling may or may not accompany low temperatures. There is a strong rhythmical change during each twenty-four hours.

The food is known to consist of flies, beetles, and aphids; no doubt other insects too are eaten. It is very probable that termites form a large part of the diet, for they are frequently abundant in the rotten debris under or in which specimens are found; moreover, captives can be maintained in good health over long periods on a diet of termites. Live insects are stalked cautiously. Water is lapped up by use of the tongue and will be taken from a dish in captivity.

The young, 1 or 2 for each female, are born from late August to the end of December. Cowles observed eleven births, in seven of which 2 young were born, while only 1 appeared in four cases. In his region, southwestern California, births occur from late August to early October, and generally during the first three weeks of September. He estimates the period of gestation at about 4 months, and observed the height of sperm formation during the first half of June.

Prior to birth, the female appears somewhat more restive than normal. This period of unrest may begin some twenty or twenty-five minutes prior to giving birth to the young, and involves many backward movements and a licking of the mouth, and also of the spectacle of the eye. None of the acts described nor all of them together provide an inevitable warning of the approaching event. The first reliable symptom of parturition "birth pains" appears to be an elevation of the

femora to a nearly vertical position, so that they assume a marked "V" posture. This elevation of the legs may be repeated several times, and probably indicates the stretching of the pelvic and associated muscles. Just prior to birth the legs are maintained in this elevated position for as much as three minutes, but they are lowered just before the expulsive movements become evident.

During actual birth the legs are returned to the normal position and support the body and vent well above the ground. At this time the body of the parent is strongly flexed, so that the snout almost touches the vent. In this position the foetus, with its enveloping membrane, is partially protruded. When the membranes appear the mother grasps the foetal envelope in her teeth and rips it open. This action seems to activate the young. In any event, the violent struggles that follow release the tail and hind legs of the foetus. The young are extruded tail, or rather breech, foremost, and back down. Thus the aimless grasping movements of the hind limbs and the thrashing of the tail result in engaging these members about the base of the parent's tail. If the young pauses in its struggle, the mother may, and usually does, nip the young in the exposed flank and leg. This appears to act as a stimulant and the young thrash violently and by their contortions extricate themselves from the parental cloaca. As they touch the ground they right themselves and run to a distance of 2 or 3 inches.

Since the young leave the foetal membranes within the cloaca, these must be extracted; the parent grasps the protruding membranes in her mouth, gradually draws them out and swallows them. After removing the egg case and its contained liquids, she licks up any droplets of fluid that may have fallen to the ground, and resumes a normal posture. This entire procedure from the moment the foetal membranes appear at the opening of the cloaca until all visible traces of birth have been removed, requires about two minutes. . . .

The average length of the parent from snout to vent is 40.5 mm., with a maximum 41 mm., and minimum 39 mm. . . . The largest foetus, 51 mm., was born from the smallest parent (Cowles).

In no other American lizards have parents been recorded eating the foetal membranes, although the habit is well known in mammals.

Problems. The life history is poorly known, as is the normal behavior of the lizard in its natural environment. Because of its nocturnal habits these have not been studied or observed in as much detail by casual effort as have the habits of many diurnal lizards.

References. Atsatt, 1939, pp. 262–264, color changes (*lit. cit.*); Cowles, 1944, pp. 98–100, fig. 1, parturition (*Calif.*); Fisher, 1936, pp. 172–176, figs. 1–2, variation, habits (*lit. cit.*); Klauber, 1931, p. 8, habits (*gen. lit.*); *idem*, 1939, pp. 74, 76, 80, 90, 97, 98, table 15, habits, habitat, records (*Ariz.*); Van Denburgh, 1922, pp. 477–482, pl. 49, description, range, localities, habits, habitat (*gen. lit.*); Young, 1942, pp. 19–32, figs. 1–11, anatomy (*lit. cit.*).

The Skinks

FAMILY SCINCIDAE

This is another family poorly represented in this country. In fact, it is poorly represented in the whole Western Hemisphere, where only five genera occur, as opposed to some thirty that occur in the Eastern Hemisphere. Within this hemisphere the United States is better represented by number of species and genera than any other region, save perhaps Mexico. In the East Indies skinks are exceedingly common, as are iguanids in this hemisphere.

The family is characterized by the flat, rounded, overlapping scales generally of more or less equal size over all the body, and by the osteoderms (bony plates) within the scales. There are no femoral pores. The eyelids are well developed. The head has large regular plates.

One of the most conspicuous features of the family is the tendency of many genera or groups of genera to have degenerate limbs. A number of species are limbless, have feeble vestiges of limbs, have a reduced number of digits, or simply have weak limbs.

Most of the species of the family are young-bearers, instead of being egg layers.

KEY TO GENERA OF SCINCIDAE

1\. Legs very short, with not over 2 digits (Fig. 93); foreleg about as long as distance from eye to nostril; lower eyelid with a translucent window . . . . *Neoseps* (p. 395)

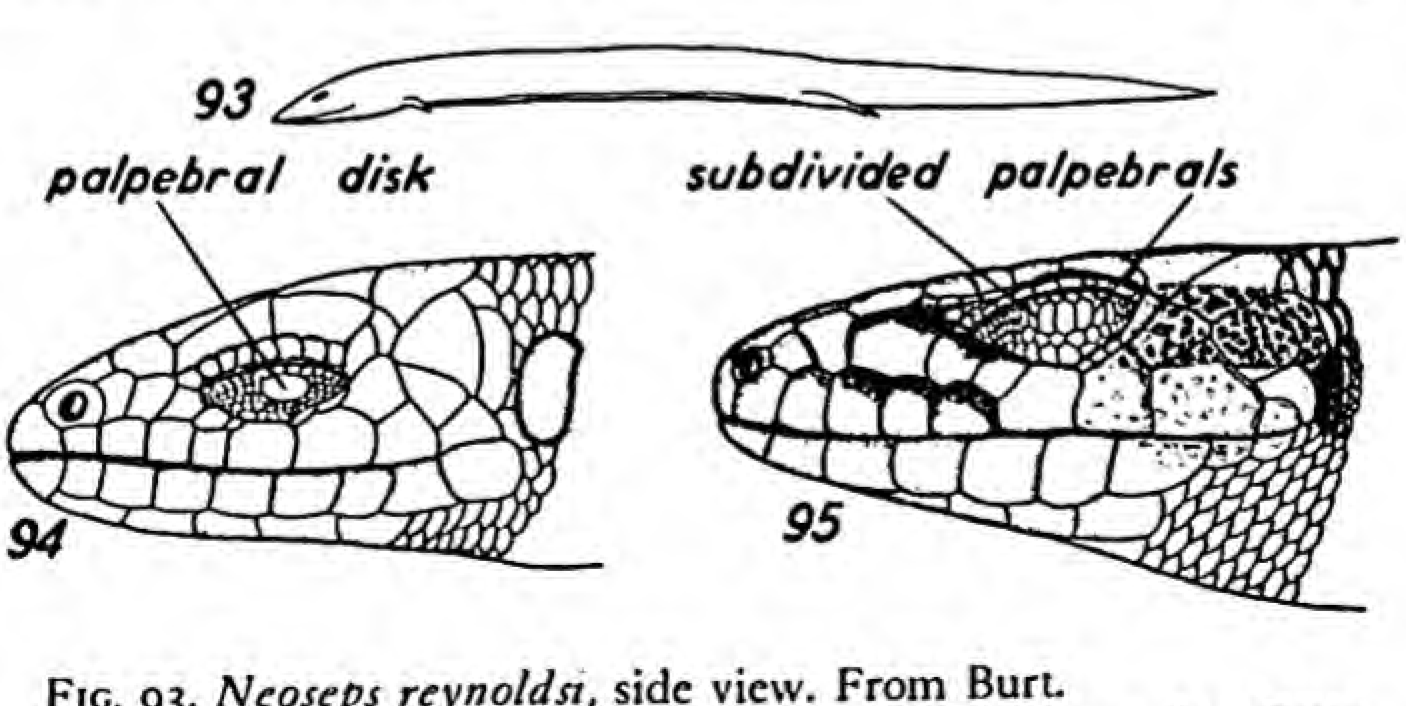


FIG. 93. *Neoseps reynoldsi*, side view. From Burt.

FIG. 94. *Leiolopisma laterale*, side of head. From Burt, after Ortenburger.

FIG. 95. *Eumeces fasciatus*, side of head. From Burt, after Ortenburger.

Legs longer, each with 5 digits 2
2. No supranasals (Fig. 96); lower eyelid with a "window," a translucent disk (Fig. 94); no longitudinal light stripes . . . *Leiolopisma* (p. 335)
Supranasals present (Fig. 97); eyelids scaly throughout (Fig. 95); longitudinal light stripes present or not . . . . *Eumeces* (p. 340)

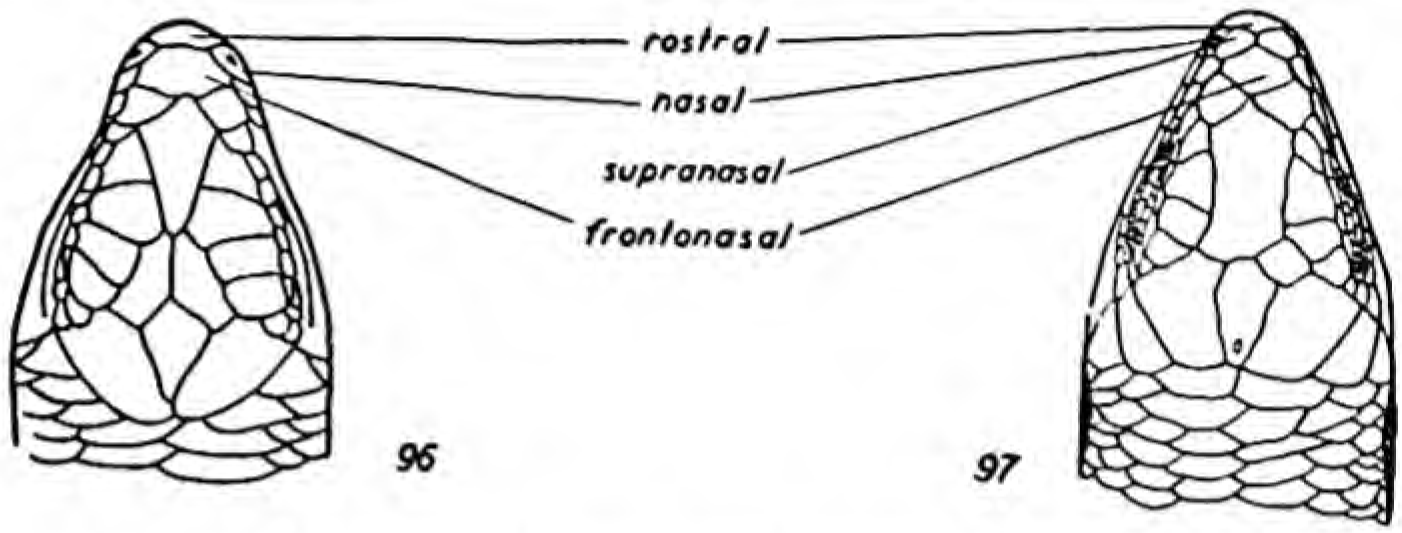


FIG. 96. *Leiolopisma laterale*, top of head. From Bocourt.
FIG. 97. *Eumeces multivirgatus*, top of head. From Taylor.

The Window-eyed Skinks

Genus *LEIOLOPISMA* Duméril and Bibron

There are few genera of the United States that enjoy the distinction of occurring in both hemispheres. Yet two of those genera are in the family Scincidae; one of them is the present genus, the other *Eumeces*.

Leiolopisma is widely distributed, from Australia through the East Indies to southeastern Asia, and in eastern United States south to Panama. Some twenty-six occur in the Eastern Hemisphere, and about ten in the Americas. All species have a more or less transparent disk in the lower eyelid.

The proper generic name of the American species and of all of the related species of the Old World has been under discussion recently by Malcolm Smith (1937 *lit. cit.*) and Stuart (*lit. cit.*). Smith refers all of the many groups related to *Leiolopisma* to the genus *Lygosoma*. A huge assemblage of hundreds of species of extraordinarily wide variety of form is thus brought together under one generic name. This arrangement does not permit the recognition of the many phylogenetic groups within the genus—groups the recognition of which certainly is more discerning and conveniently useful than the combination of all under one name. Admittedly the groups have yet to be properly defined and delimited, but until this is done little is gained by lumping everything because everything cannot yet be satisfactorily defined. Subgenera distinguished by Smith might be utilized as generic names simply by elevating their rank; but if this were done, *Hemiergis* would be used as

the genus for our United States species. *Hemiergis* actually was based originally on elongate, degenerate-limbed, Australian species, and is not the same as our genus. If one then restricts the name *Leiolopisma* to the species exclusive of *Hemiergis,* one finds that, by Smith's grouping, two genera must be used for the American species—one genus (*Leiolopisma*) for species such as *laterale* of the United States with paired frontoparietals, and another (*Lampropholis*) for the several Mexican and Central American species with an

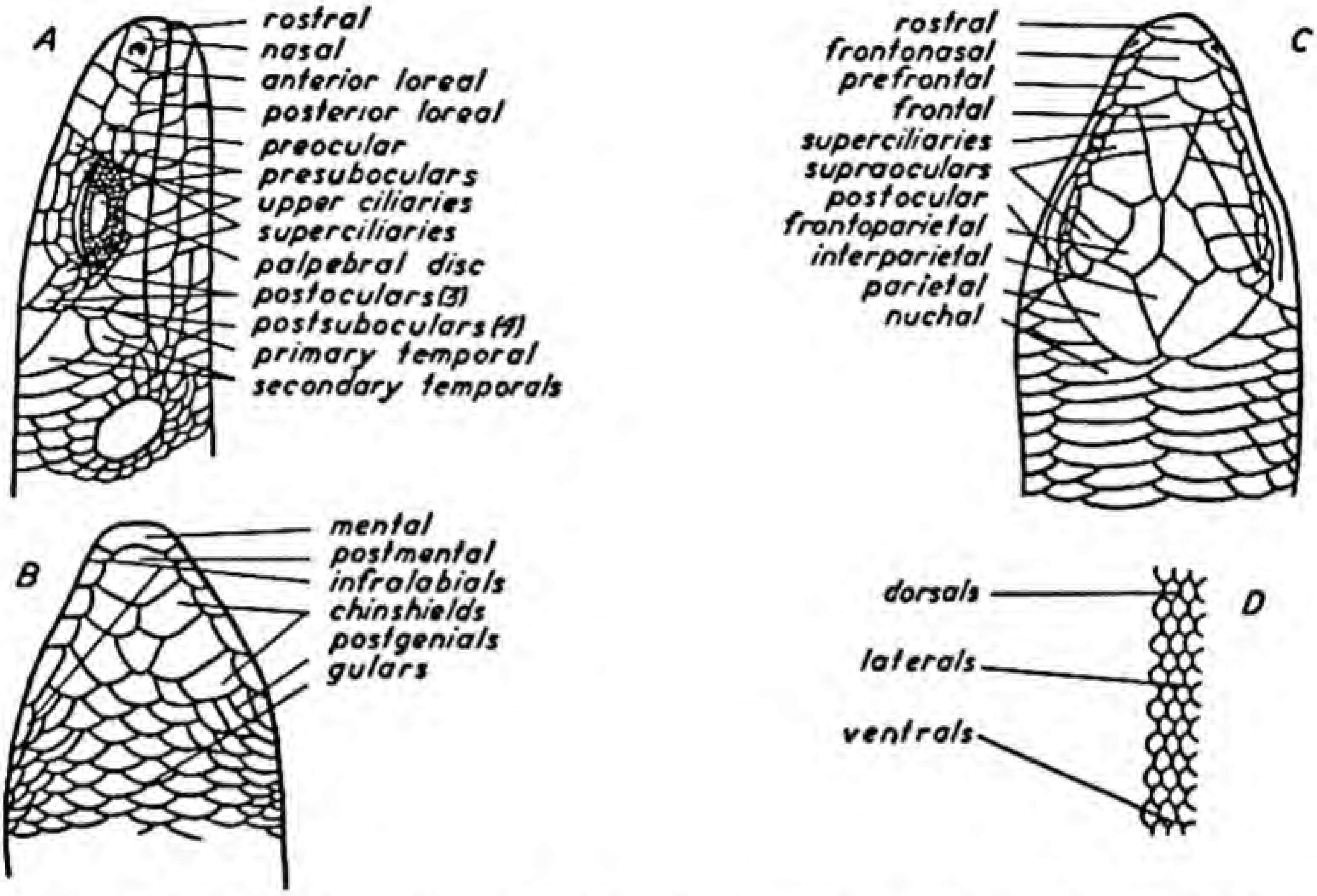


FIG. 98. Typical scutellation in *Leiolopisma,* from *L. laterale,* Imboden, Arkansas. A, lateral view of head; B, ventral view of head; C, dorsal view of head; D, section of body in side view.

entire frontoparietal. Yet all American species are so similar that the condition of the frontoparietal (whether paired or entire) is almost the only character that will distinguish some of them. In fact I have seen one specimen belonging to a species which should have a single frontoparietal, but which actually had paired parietals. The conclusion is apparent that this character is of no great generic significance in this hemisphere, although it may be elsewhere; and since *Leiolopisma* is the oldest name applied to the American species, it should be used for our species.

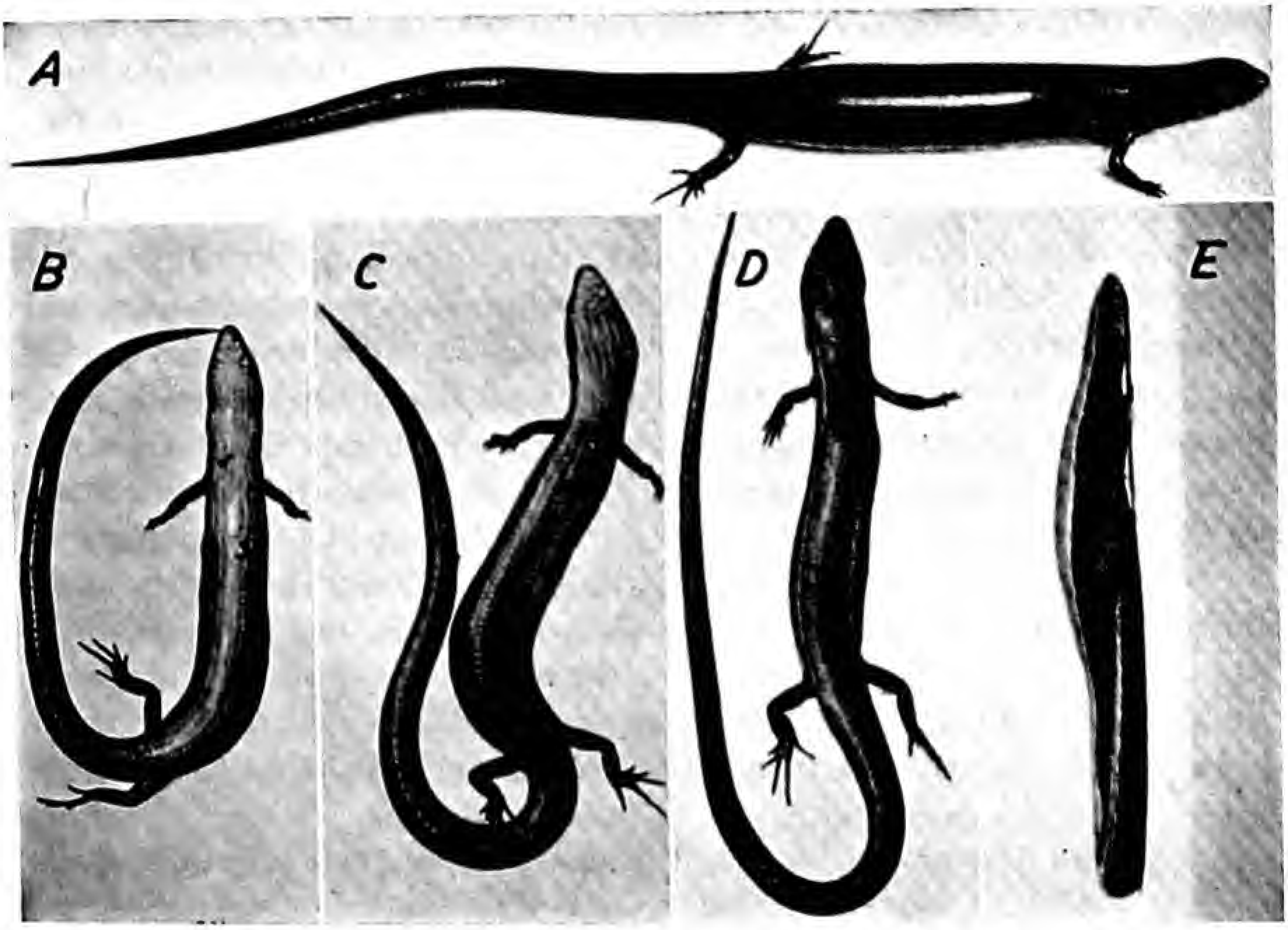
The single species of the United States, *laterale,* belongs to the group of the genus with paired frontoparietals. Three others of the group are known, all occurring along the eastern slopes of central and northern Mexico. Some details of the scutellation of the United States species, a typical member of the genus, are shown in Fig. 98.

Brown Skink *Leiolopisma laterale* (Say)

(Fig. 94, p. 334; Fig. 96, p. 335; Fig. 98, Pl. 92)

Range. Southeastern Kansas south to the Gulf of Texas, northeast to southern New Jersey, southward through all the eastern states and throughout Florida. Type locality—southern states. (Map 25, p. 500.)

Size. These are small, slender, short-limbed lizards reaching a usual maximum length of about 48 mm. (1⅞ in.) snout to vent. The tail, when complete, is a little more than 1½ times as long as the body; it usually has a regenerated



Pl. 92. *Leiolopisma laterale.* A, Patuxent Research Refuge, Bowie, Maryland. U.S. Fish and Wildlife Service photograph. B, Somerset, Texas; male. C, Helotes, Texas. D, Somerset, Texas; male. E, Somerset, Texas; male.

part, which is shorter than the original. Burt records a maximum snout-vent length of 81 mm. (3³⁄₁₆ in.) and a tail length 3 times that of the body. The limbs are very short, about equal, the hind leg a little more than ⅓ the snout-vent length; when pressed against the sides of the body the limbs fail to touch by some 10 to 20 scale lengths.

Color. These are dark brown skinks, light brown above and with a dark brown, lateral stripe. The dorsal brown area covers 6 full and 2 half scale rows. The lateral stripe has a well-defined, straight, median edge, and extends forward above the ears and through the eye to the tip of the snout. The lower

edge of the stripe, on the head and neck, is generally well defined, the stripe about 2 full to 2 full and 2 half full scale rows wide. On the sides of the body the lower edge of the stripe is not well defined except in light specimens from certain parts of the range; in these it is but little broader than on the neck. In most specimens the stripe fades laterally into the very light brown hue of the sides, which are sometimes but little darker than the belly. Some very dark specimens, from certain parts of the range, have the entire sides of the head, neck, and body dark brown, sharply differentiated from the white belly; the back also is quite dark.

The lower labial region is usually barred or suffused with dark brown; in some the whole gular region is irregularly pigmented. The tail is brown, dark or light according to the color of the dorsal and lateral surfaces of the body, which it matches; if moderately light, the lateral dark stripe can be seen where it extends onto the base of the tail. The ventral surface of the tail, near the base, is light as the belly, but a short distance from the base becomes pigmented and as dark as the dorsal surface.

Scalation. See Fig. 98. The scales are all small, very smooth, flat, and rounded. There are 26 to 32 rows around the middle of the body, usually 28 or 30, and 77 to 80 scales from parietal to above anus. The head scales are large and regular; more important among them is the large frontonasal broadly in contact with the rostral; no supranasals; a large elongate frontal in contact anteriorly with frontonasal, narrowly in contact with the 2 frontoparietals posteriorly; a large parietal on each side, narrowly in contact behind the small, median interparietal; 4 large supraoculars, second largest; 7 upper labials, four smallest. A most peculiar feature is the transparent window in the lower eyelid. There are 2 to 4 pairs of enlarged nuchal scales. Two large and 2 small scales precede the anus. The median row of subcaudal scales is somewhat enlarged.

Recognition Characters. The small species has a number of peculiar characters to identify it. No other lizard in the United States with well-developed limbs has a window in the lower eyelid and no other skink (smooth-scaled lizard with legs) lacks supranasals. The brown lateral band and the absence of light stripes, combined with the perfectly smooth flat scales, also identify this species. In fact, there are no extremely close relatives in the United States. There are several related species in Mexico and Central America, however, and there is a species in China so much like it that some specialists consider it identical with our common United States species.

Habitat. Restricted mostly to wooded areas where they are found on the ground among leaves and other debris. They occur in both pine woods and deciduous forests. They are less commonly found in open fields or on grassy hills, under stones and logs. They prefer moist places, frequently occurring near streams.

Habits. These are very quietly moving, nervous lizards seen most frequently crawling about in leaves or on the ground, seldom climbing. They are very wary and hide under debris or in leaves when disturbed; they are usually seen moving in their normal manner only when the observer remains quietly in one spot. When running they make serpentine lateral movements. When disturbed they run a short distance, scurry under the leaves if these are present, and then remain motionless. Because of their small size and secretive habits they are not frequently seen unless special search for them is made. There are reports, unconfirmed, that these are nocturnal lizards. I believe they are exclusively diurnal, although they have been observed moving about until sundown. In Oklahoma they are active from the first of April to the middle of October.

Carr reports seeing individuals, "unable to find cover on the banks of brooks, jump into the water and swim so rapidly as to appear to be running across the surface; one of these . . . dived to the bottom in four or five inches of water and thrust its head under a stick." He reports finding tails of the same species in the stomachs of four specimens, "each of which had recently lost its own tail . . . in each case the stub remaining on the animal plus the portion in the stomach constituted a tail of the proper facies and dimensions. Since one of the specimens was a female, it seems illogical to attribute the mutilation to pre-courtship fighting." He infers that autophagy may occur and cites as support of this inference an observation upon a specimen of *Eumeces laticeps* which, after regarding its tail a moment, wriggled the member a little, and then after seizing it in its jaws, broke off a portion and swallowed the piece avidly.

The food consists of small insects, larvae and adults alike. In captivity these lizards feed readily upon flies. Spiders very possibly form a considerable portion of their diet, since they forage in a manner that should reveal much of this type of prey, yet these have not been recorded. Millipeds, pillbugs, beetles, and earthworms are eaten.

The eggs are 1 to 5, usually 3 in number, laid in humus, rotten stumps, logs, etc. They measure 8 to 9.5 mm. in length and 3.5 to 4.5 mm. wide, and have a calcareous deposit on the tough shell. The shells are said to be very thin. The egg-laying period extends from early June to early August. Hatching occurs in late August and probably throughout most of September.

Problems. The life history and habits of these small lizards are poorly known, perhaps because of their small size and secretive habits. A study of the variation very probably will reveal a number of geographical races.

The specific name of this skink has been rather unsettled of recent years, some authors believing it should be known as *L. unicolor*, others maintaining *L. laterale* is correct. The problem depends upon the interpretation of the International Rules of Zoological Nomenclature, which do not specifically state

what should be done with secondary homonyms. However, in conformity with a pending opinion of the International Commission, *laterale* is used here.

References. Burt, 1928, pp. 45–49, habits, description (*Kans.*); Carr, 1940, pp. 74–75, habits, Florida range (*Fla.*); Cook, 1942, pp. 14, 18, habits, Mississippi range (*Miss.*); Force, 1930, p. 28, eggs (*Okla.*); Gloyd, 1928, p. 120, eggs (*Kans.*).

The Opaque-lidded Skinks

Genus *EUMECES* Wiegmann

Like *Leiolopisma,* this genus is distributed widely in the Old World as well as the New, occurring in southeastern Asia, southwestern Asia, northern Africa, the Bermuda Islands, and southern Canada to Panama. In 1936 Taylor recognized 57 forms in the genus, of which 21 were restricted to the eastern hemisphere. The number of species has been increased slightly since his monograph appeared.

The genus is characterized by the conical, pleurodont teeth; the scaly nature of the eyelids, which lack a partially transparent disk; the presence of teeth on the pterygoid bones; and the separation of at least the pterygoid and usually the palatine bones also on the median line of the palate. This latter character is one of the most important of all, for it separates the genus from another, *Mabuya,* which is very similar otherwise and very easy to confuse with it. This character can be determined by cutting the muscles in the corner of the mouth and pulling the lower jaw ventrally until the roof of the mouth is exposed to view. The long median slit is characteristic of *Eumeces;* when the slit is closed in the anterior half of its length, then some small amount of scraping must be done to see what bones are involved and whether actual contact of them medially is achieved. Some details of the scutellation of a typical United States species are shown in Fig. 99.

Taylor segregates the species of the genus into fifteen groups, seven of which occur in the United States. These seven groups are represented in our country by nineteen species and subspecies as delimited at present. This is more than in any other genus, save *Sceloporus,* which is represented within our borders by twenty-seven forms.

Although most of our species are terrestrial, a few are arboreal. Some seem to be subfossorial, tending to burrow to some extent. Some of the Asiatic species are more definitely fossorial.

All of the United States species lay eggs, but a few Mexican species give birth to their young. Some egg-laying species brood their eggs.

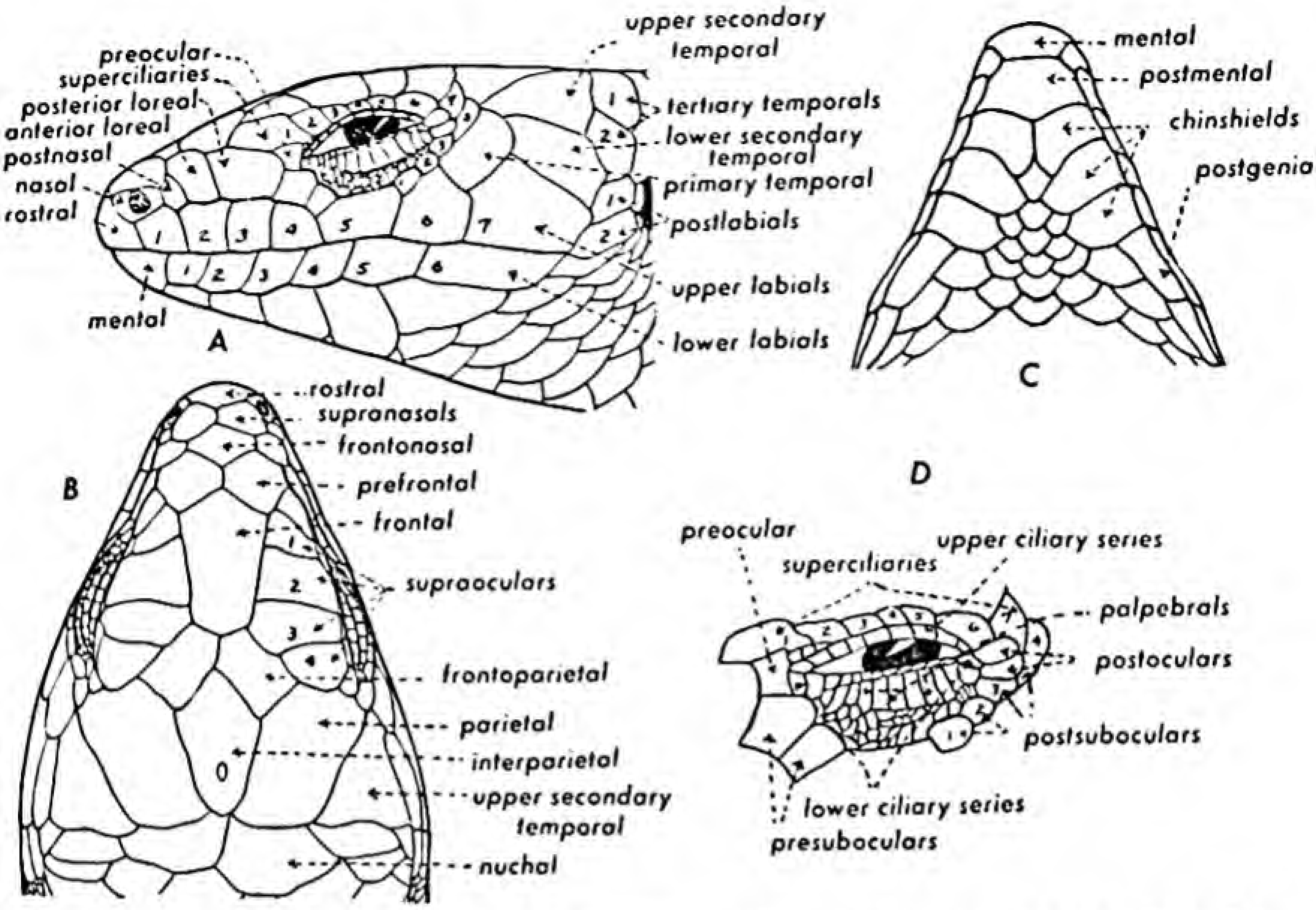
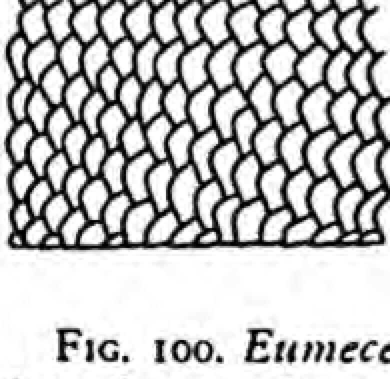


FIG. 99. Typical scutellation in *Eumeces*, species not determined. A, side of head; B, top of head; C, underside of head; D, orbital region, side view. From Taylor.

All forms are diurnal and carnivorous. Larger species may feed upon small vertebrates, including the young of their own kind.

KEY TO SPECIES OF *EUMECES*

1. Lateral scales in rows oblique to the dorsal rows, extending postero-dorsally (Fig. 100); young black, adults light with small black areas either arranged in a linear fashion or forming a dark border on each scale .... *obsoletus* (p. 361)
   Lateral scales in rows parallel to those on back (Fig. 101); young not black, adults not as described 2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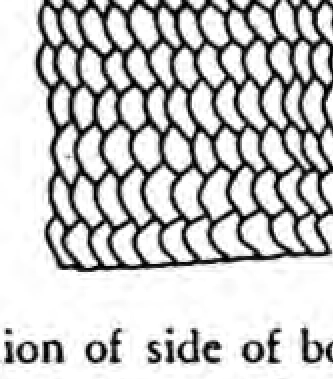
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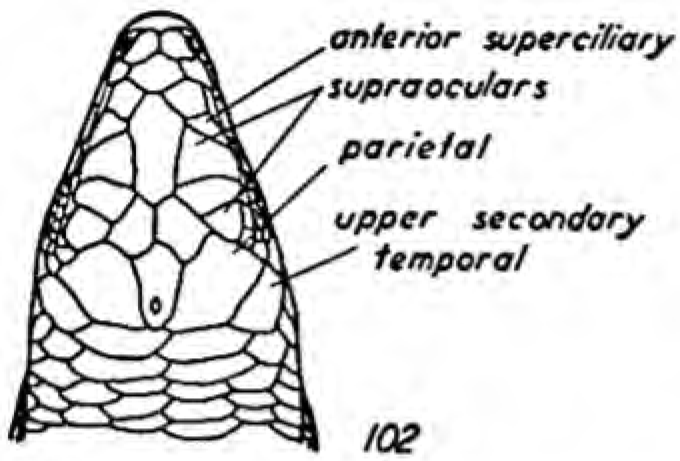
FIG. 100. *Eumeces obsoletus*, section of side of body in lateral view. For best effect hold page near eye level and look across the figure. From Ortenburger.

FIG. 101. *Eumeces fasciatus*, section of side of body in lateral view. From Ortenburger.

2. Dorsolateral light stripes, if at all visible on any part of body, involving second scale row (counting from middorsal line) on at least anterior part of body; no median light line on head or body 3
   Dorsolateral light stripes not present or if present not involving second scale row; median light line present or absent 8



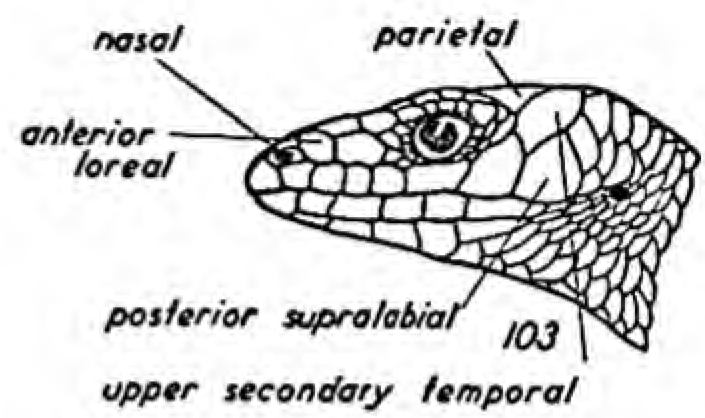
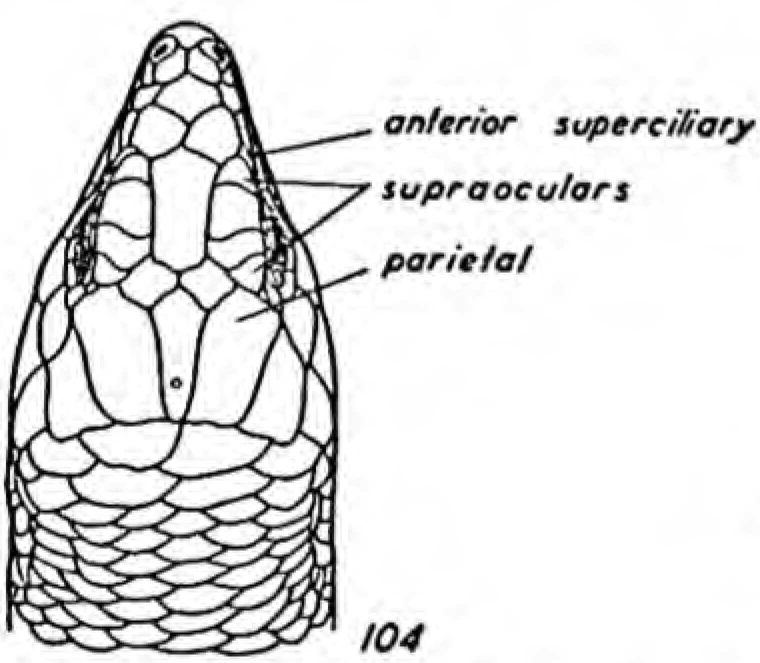


Fig. 102. *Eumeces egregius,* top of head. From Taylor.
Fig. 103. *Eumeces egregius,* side of head. From Taylor.

3. One large scale (upper secondary temporal) between last labial and parietal; no postnasals; 3 supraoculars (Figs. 102, 103) 4
   Two large scales (upper and lower secondary temporal) between last labial and parietal; a postnasal; 4 supraoculars (Figs. 104, 105) 5



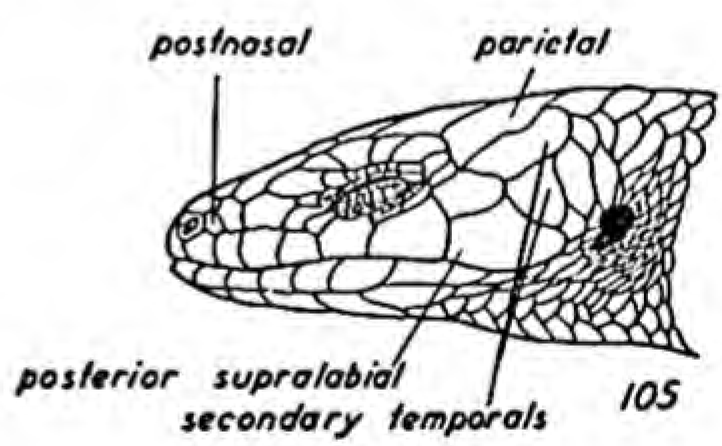


Fig. 104. *Eumeces rubricaudatus,* top of head. From Taylor.
Fig. 105. *Eumeces rubricaudatus,* side of head. From Taylor.

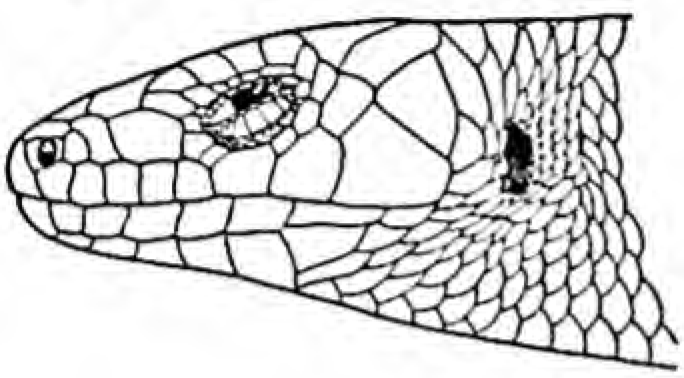
4. Dorsolateral light lines generally short, but if full length, their inner borders posteriorly on third scale rows; median dorsal pair of scale rows only slightly larger than adjacent rows .... *onocrepis* (p. 393)
   Dorsolateral light lines extending the full length of the body, their inner borders on the second scale rows; median dorsal pair of scale rows much larger than adjoining rows .... *egregius* (p. 391)
5. Young red-tailed; dorsolateral light stripe including more than half of second scale row; interparietal very long and narrow, its sides nearly parallel (Fig. 104) .... *rubricaudatus* (p. 388)
   Young blue-tailed; interparietal shorter, broader, its sides distinctly

and strongly converging posteriorly (Fig. 107); dorsolateral light stripe involving more or less than half of second scale row 6

6. Jubals usually (about 90 per cent or more) 1–1 or 1–2; supralabials frequently (60 per cent or more) 7–8 or over; adults losing stripes and attaining a length (snout-vent) of 113 mm. 7

   Jubals usually (about 70 per cent) 2–2; supralabials usually (60 per cent) 7–7 or 6–7; adults retaining juvenile pattern at least in part; maximum snout-vent length 83 mm. .... *skiltonianus* (p. 380)

106



107

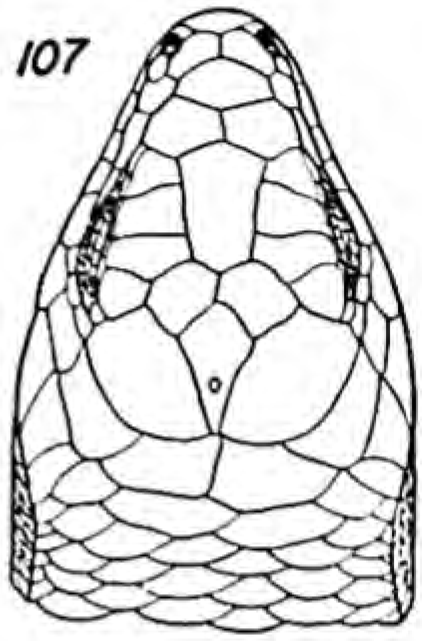


FIG. 106. *Eumeces g. gilberti*, side of head. From Taylor.
FIG. 107. *Eumeces g. gilberti*, top of head. From Taylor.

7. Supralabials generally (70 per cent) 8–8 or 8–9; dorsolateral light stripes lost at sizes over 55 mm. snout to vent ..... *gilberti gilberti* (p. 384)

   Supralabials generally (70 per cent) 7–7 or 7–8; juvenile markings retained in part throughout life in females, and to a length of 92 mm. (snout-vent) in males .... *gilberti placerensis* (p. 386)

8. A dorsolateral light line extending the full length of body on *only* the third scale row 9

   Not so 10

9. No median light stripe in either young or adult .... *gaigei* (p. 365)

   Light median stripe present at least in the adult, and sometimes in the young as well; adults with other, secondary, light lines .... *multivirgatus* (p. 367)

10. Light lines (dorsolateral or medial) not evident on either neck or trunk 11

    Light lines present on neck or trunk, or both 17

11. No postnasal; median subcaudals not greatly widened; extreme southern Texas .... *tetragrammus*[1] (p. 360)

    Postnasal present; median subcaudals widened or not; not in extreme southern Texas 12

12. Median subcaudals not or scarcely widened; southeastern United States .... *inexpectatus*[2] (p. 351)

    Median subcaudals distinctly expanded transversely 13

[1-2] Young with light lines.

13. Median subcaudals about 4 times as wide as long 14
    Median subcaudals not over 3 times as wide as long, usually less . . 15
14. Interparietal with nearly parallel sides (Fig. 104); head not red; scale rows frequently 24 . . . . *rubricaudatus*[3] (p. 388)
    Interparietal with distinctly converging sides (Fig. 107); head poppy red; scale rows usually 26 7
15. Limbs long, overlapping 16
    Limbs short, not touching except perhaps in very young . . . . . *taylori* (p. 371)

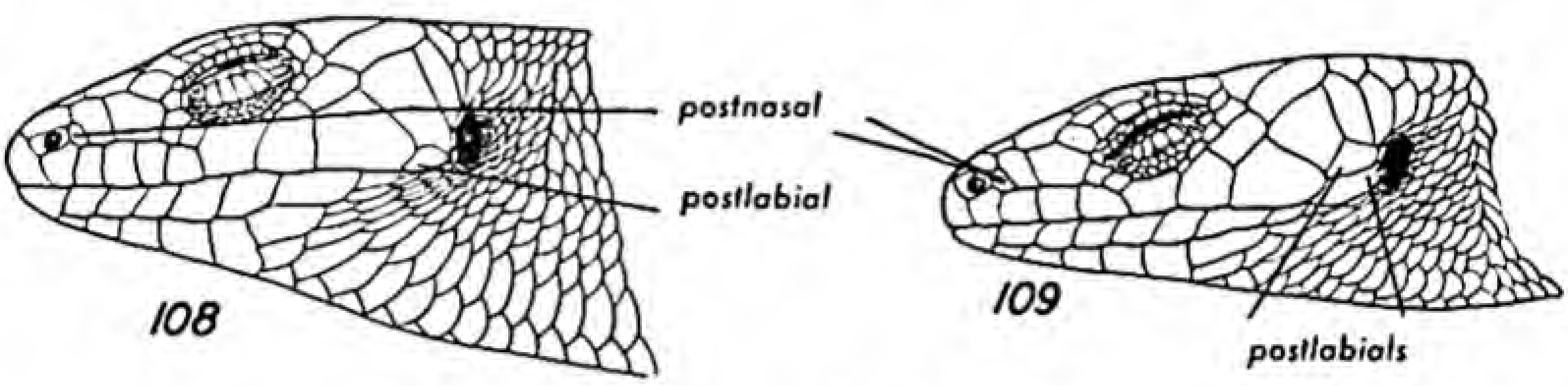


FIG. 108. *Eumeces laticeps,* side of head. From Taylor.
FIG. 109. *Eumeces fasciatus,* side of head. From Taylor.

16. No postlabials, or 1 or 2 of very small size (Fig. 108); lateral intercalary scales on fourth toe reaching onto next to last phalanx (Fig. 110); maximum snout-vent length 130 mm. (5¹⁄₁₆ in.) . . *laticeps*[4] (p. 353)
    Two postlabials of relatively large size (Fig. 109); lateral intercalary scales on fourth toe not reaching penultimate phalanx (Fig. 111); maximum snout-vent measurement 80 mm. (3⅛ in.) . . *fasciatus*[5] (p. 347)

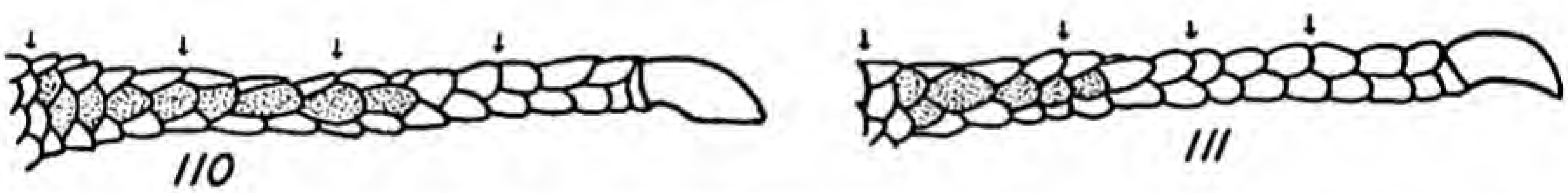
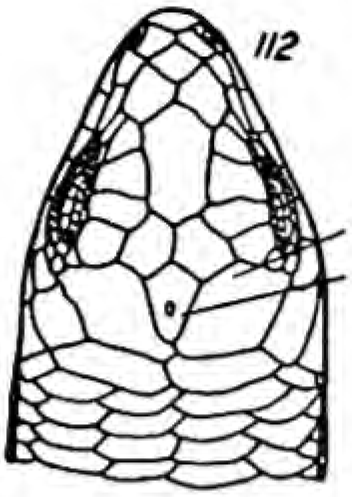


FIG. 110. *Eumeces laticeps,* posterior surface of right fourth toe. Joints between phalanges indicated by arrows. Postdigital (lateral) scales stippled.
FIG. 111. *Eumeces fasciatus,* as in Fig. 110.

17. Postnasal present (Figs. 108, 109) 23
    Postnasal absent (Fig. 113) 18
18. A pair of light lines on top of head, *generally* visible posteriorly at least to nuchals, where they unite in a single line 19
    No light lines whatever visible on dorsal surface of head; body with or without a median light line 21
19. Parietals enclosing interparietal posteriorly (Fig. 112); an elongate postlabial (Fig. 113) . . . . *callicephalus* (p. 358)
    Parietals not enclosing interparietal posteriorly (Fig. 114); several postlabials, at least in 2 transverse rows (Fig. 115) 20
20. Dorsolateral and lateral light lines extending the full length of the

[3-5] Young with light lines.



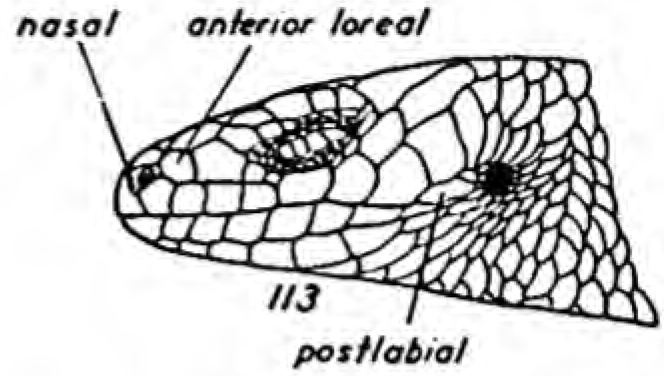
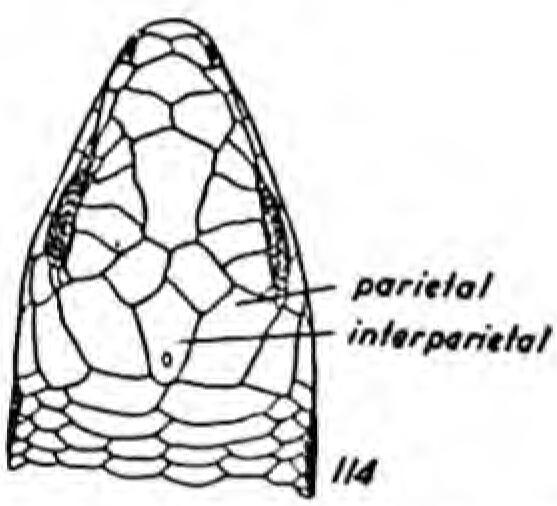


FIG. 112. *Eumeces callicephalus*, top of head. From Taylor.
FIG. 113. *Eumeces callicephalus*, side of head. From Taylor.

body; lines on top of head disappearing posteriorly before uniting . . . . . *tetragrammus* (p. 360)

Dorsolateral and lateral light lines disappearing on posterior half of body; lines on top of head usually visible to point of union on nuchals . . . . . *brevilineatus* (p. 356)



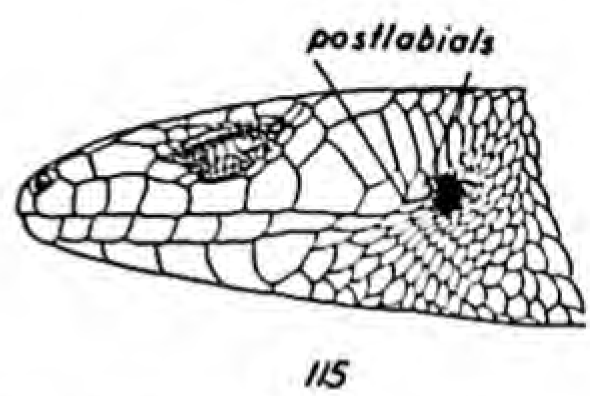


FIG. 114. *Eumeces brevilineatus*, top of head. From Taylor.
FIG. 115. *Eumeces brevilineatus*, side of head. From Taylor.

21. One postmental (Fig. 116); limbs overlapping when adpressed except in very large females; dorsolateral light lines not edged medially with black . . . . . *anthracinus* (p. 372)

Two postmentals (Fig. 117); limbs not overlapping or touching except in young; dorsolateral light lines edged medially with black 22

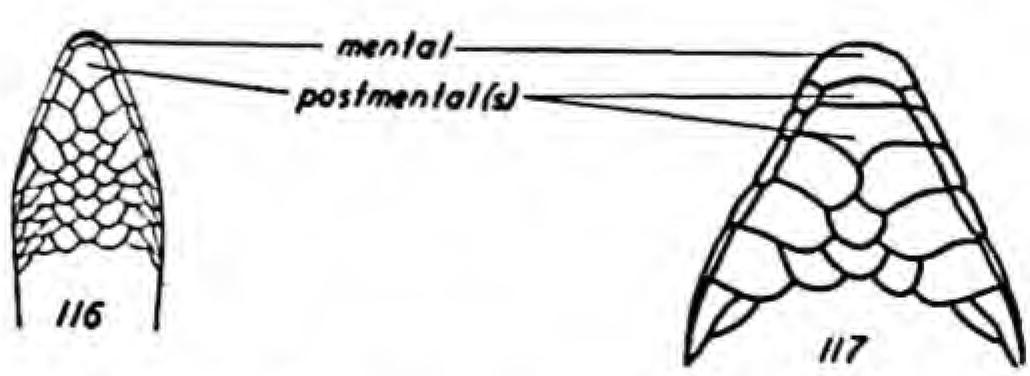


FIG. 116. *Eumeces anthracinus*, underside of head. From Burt.

FIG. 117. *Eumeces septentrionalis obtusirostris*, underside of head. From Bocourt.

22. Frontonasal small, absent, or fused with adjacent scales, but not in contact laterally with anterior loreal (Fig. 118); a median light line frequently present, reaching as far as parietal; scales from parietal to posterior border of thigh average about 60 .... *septentrionalis septentrionalis* (p. 375)
    Frontonasal present, generally in contact laterally with anterior loreals (Fig. 119); a dim median line frequently absent, usually not reaching head when present; scales from parietal to posterior border of thigh average about 57 .... *septentrionalis obtusirostris* (p. 377)

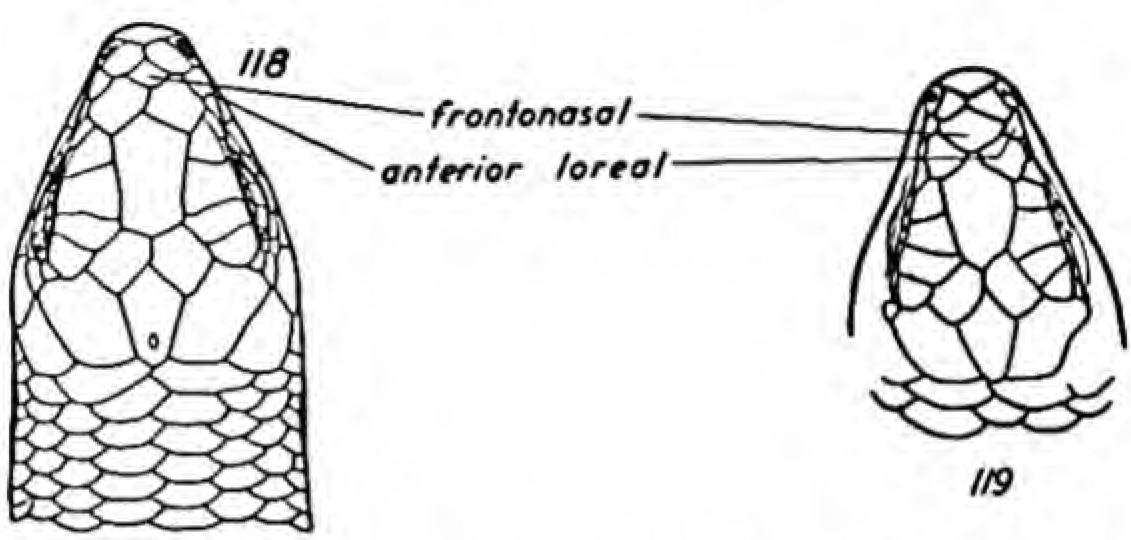


FIG. 118. *Eumeces s. septentrionalis,* top of head. From Taylor.
FIG. 119. *Eumeces septentrionalis obtusirostris,* top of head. From Bocourt.

23. Subcaudal scales near base of tail, on *unregenerated* parts, not or scarcely wider than long; dorsolateral light stripes, when visible, never including third scale row .... *inexpectatus* (p. 351)
    Subcaudal scales throughout length of tail much wider than long; dorsolateral light stripes, when visible, frequently including third scale row 24
24. No postlabials, or 1 or 2 of very small size (Fig. 108); dorsolateral light stripes, when visible, usually not involving third scale row; lateral stripes reaching anterior border of ear at its upper margin, not directed straight through the ear; size frequently over 85 mm. (3¼ in.) snout to vent .... *laticeps* (p. 353)
    Two postlabials of relatively large size (Fig. 109); dorsolateral light stripes, when visible, usually involving third scale row; lateral stripes directly through middle of ear, not directed toward the upper anterior margin of ear; size not over 85 mm. snout to vent *fasciatus* (p. 347)

The Five-lined Skinks—Fasciatus Group

There are three American species, all confined to eastern United States, and nine Asiatic species, all confined to southeastern Asia. The distribution is curious. All of our species have a median and 2 lateral light lines on each side,

except in adult males; in all species, the latter become a nearly uniform tan and lose their stripes as they reach large size.

The group may be recognized by the combination of having a postnasal (Figs. 108, 109) 2 postmentals (as in Fig. 117) and either 5 light lines or none at all (adult males). The only species with similar characters are the western four-lined skinks, adult males of which lose their stripes as do the eastern five-lined species. It must be understood that in unusual specimens the postnasals may be absent, or there may be only 1 postmental; about three specimens in a hundred will be anomalous in either of these respects.

Common Five-lined Skink *Eumeces fasciatus* (Linnaeus)

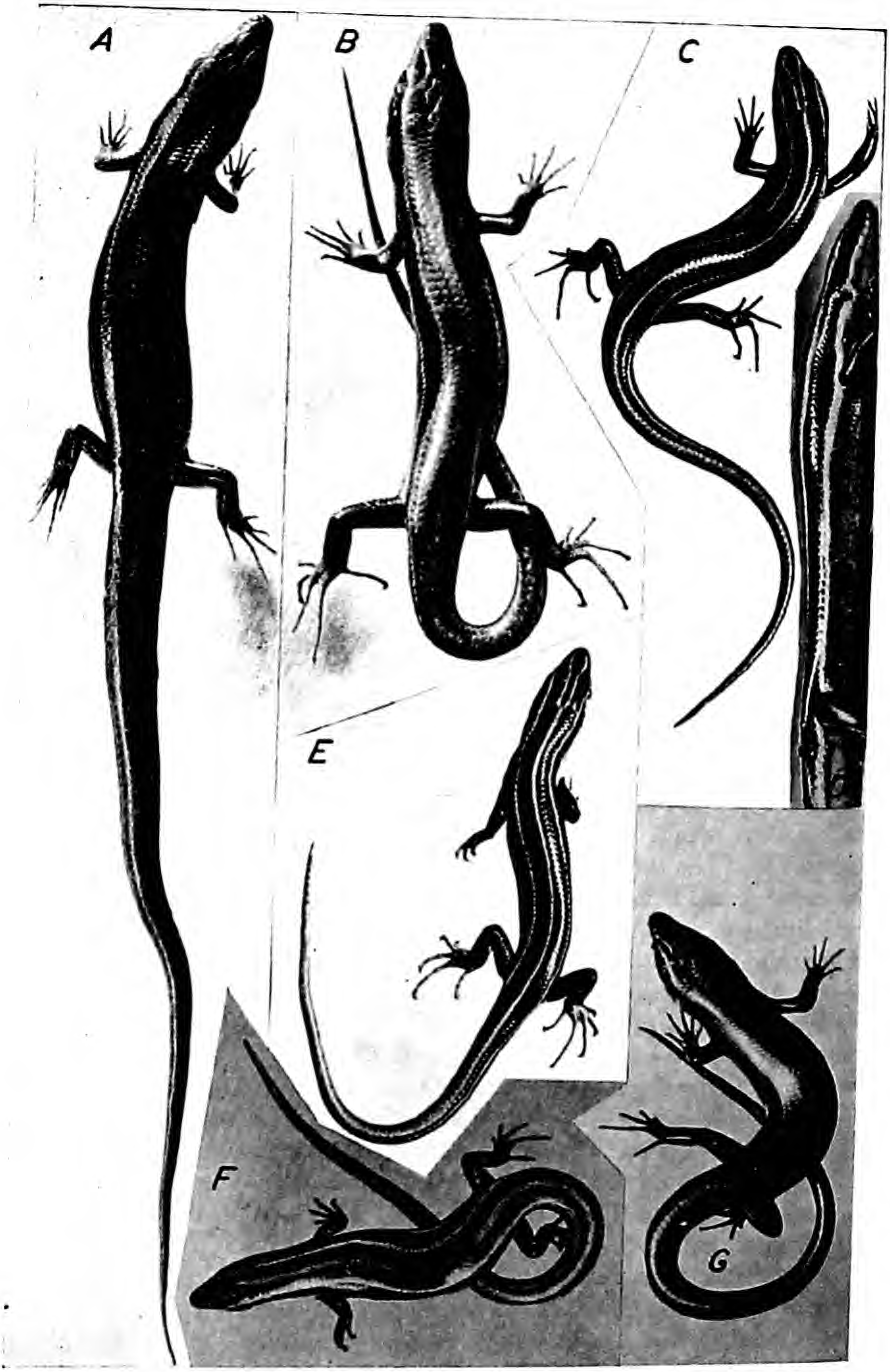
(Fig. 95, p. 334; Fig. 109, p. 344; Fig. 111, p. 344; Pl. 93)

Range. Southeastern South Dakota, midwestern Oklahoma and central Texas eastward to the coast, southward from southern Ontario and extreme southeastern New England to, but not including, Florida. Type locality—Carolina. (Map 26, p. 501.)

Size. The maximum snout-vent record for this species is 80 mm. (3–⅛ in.) in males; females are somewhat smaller. The tail is equal to or a little less than twice the head-body length. The limbs overlap when adpressed. The young when hatched measure 58 to 65 mm. (2¼ to 2⁹⁄₁₆ in.) in total length, and average about 25 mm. (1 in.) in snout-vent length.

Color. The body in young specimens is more or less uniform black except for 5 narrow, white or bluish white, light lines which extend about halfway onto the tail. The median light line divides on the nuchals and passes along the edges of the frontal; the halves reunite on the rostral. The dorsolateral light lines originate in the superciliary region and involve the adjacent edges of the third and fourth scale rows. The lateral light lines begin on the sides of the head, pass through the middle of the ear opening, above the insertion of the foreleg, and through the upper margin of the insertion of the hind leg. Below this a dark area blends ventrally with the belly color. The dark stripe between the lateral and dorsolateral light lines involves 1 full and 2 half scale rows. There may be a light streak along the posterior margin of the dorsal surface of the hind leg. The snout and throat are cream, and this color blends posteriorly with the bluish-gray color that covers the ventral surfaces of the body, limbs, and tail. The dorsal surface of the tail is azure blue, very brilliant in the distal half.

As the specimens reach greater size and age, brown or brownish-gray streaks form in the middle of the paravertebral dark stripes, and expand until only a narrow black streak, or none, borders the median and dorsolateral light lines. The lateral dark bands remain darker than the rest of the body, but become uniformly lighter with greater age. The tail loses all trace of the blue color. This is the condition of the pattern in young males and in all adult



Pl. 93. *Eumeces fasciatus.* A, Locust Grove, Mayes County, Oklahoma. U.S. Fish and Wildlife Service photograph. B, Ithaca, New York. C, Pennsylvania State College campus. D, Lawrence, Kansas. E, Pennsylvania State College campus. F, G, Lawrence, Kansas.

females, even the oldest. Females do not lose the stripes, except on the head, where they become dim. Old males, on the other hand, may lose all traces of light or dark lines, except for a brown, lateral, dark stripe, and sometimes faint evidence of the dorsolateral light line bordering it above; the back is olive or olive brown, and the head is reddish, at least in the breeding season.

Scalation. The chief features of the head scalation are as follows (Fig. 109): postnasal present; usually 7 supralabials; 2 well-defined, rather large postlabials between last supralabial and ear; tertiary temporal never in contact with last supralabial; 2 postmentals. The scales around the middle of the body vary from 25 to 31, but are usually 28 to 30. The median row of subcaudals is distinctly widened even at the base of the tail. The intercalated lateral row of scales on the fourth toe does not extend beyond the tip of the second phalanx (Fig. 111).

Recognition Characters. The presence of 5 lines (or lack of all lines), 1 postnasal, and 2 postmentals conclusively identify the three species of eastern five-lined skinks. These three, however, are not usually to be distinguished just by a glance; it is necessary to look at the scales. The common five-lined skink may be known by having broadened scales in the median row under the tail (this applies only to unregenerated parts, for regenerated tails of all three species have broad ventral scales), by the presence of 2 fairly large postlabials, and by the restriction of the lateral intercalary row of scales on the fourth toe to the first two phalanges. In the greater skink, the postlabials are absent, or there is but 1, or the 2 are very small; the intercalary scales on the fourth toe extend onto the third (penultimate) phalanx; and of course a much greater size is reached; any specimens measuring 85 mm. (3½ in.) or more are certainly not the common five-lined skink. In the Florida five-lined skink, the scales under the tail (near base, on unregenerated parts only) are only very slightly broadened, if at all.

A character very helpful in identifying many specimens of *fasciatus* in which the light stripes are yet visible is the inclusion of the third scale row (counting from middorsal line) in the dorsolateral light line. This species is the only one of these three, which are so easily confused, in which the third as well as the fourth scale rows are always included; in *inexpectatus* only the fourth and fifth rows are included; and in *laticeps* generally the fourth and fifth but rarely the third row also are included.

Habitat. Commonly found in wooded areas, usually on the ground, under stones, in piles of leaves, in rotten logs, etc. A moist, but not wet, environment is preferred.

Habits. During the day when temperatures are high these lizards may frequently be seen sunning themselves briefly on logs and stumps or stretched out in dry leaves. They are nervous lizards, however, and do not remain long in one place. On cool days they usually do not emerge but are found under cover. They do not wander at will everywhere but have more or less specific

abodes to which they retreat. They seldom climb trees, contrary to the habit of *laticeps* and *inexpectatus*. When captured they almost always try to bite. The pinch may be painful in some parts of the hands, but the teeth cannot penetrate the skin ordinarily. The highest elevation at which I find them recorded is 3800 feet.

Courting and mating occur in early spring, soon after emergence from hibernation (generally during May in Maryland). The preliminary courting behavior may consist of a few scratching motions of the hind legs, or of rubbing the cloaca on the ground. Active courting consists merely of rushing with open mouth at the neck of any lizard of the species that may be around; if the object of the rush fights back, it is identified as a male by the courting animal, which turns its attention to others, until he finds one that either runs away or does not fight back; such lizards are identified as females (they seldom are not), and mating ensues. The male grasps the female by the side of the neck with his jaws and curls his cloaca underneath that of the female. Copulation lasts 4 to 8 minutes and is accompanied by rhythmical movements of the pelvic region of the body; the courting procedure lasts only 5 to 7 minutes.

The eggs are laid, after a gestation period of some 6 or 7 weeks, during about a two-week period between May 23 and July 13, according to the region of the country, and the eggs hatch during a similar two-week period about 27 to 56 days later, from early July to late August and perhaps early September. McClellan thinks the normal hatching period is about 5 or 6 weeks in Maryland. The eggs are laid in clutches of from 2 to 18, smaller clutches being laid by smaller females and larger ones by the large females. There is some indication that size of the clutches decreases toward the north. They are laid in rotten logs or in loose soil several inches below the surface, and are brooded during the entire incubation period by the mother. This brooding serves a very useful function, as other lizards, even of the same species, would otherwise frequently eat the eggs; even as it is the female herself may eat the eggs if she becomes sufficiently hungry. Intruders are courageously attacked by the female. Shortly after deposition the eggs measure an average of 13 x 7 mm., but increase very notably in size; near hatching time they measure about 20 x 12.5 mm. It is noteworthy that the proportions remain the same throughout development (although McClellan produces data that indicate a relative shortening does occur). At hatching the young measure from 24 to 27.5 mm. snout to vent.

The winter is probably spent in rotten logs or in the ground; one was once found hibernating in sawdust piles, and two in Kansas were found in ground at a depth of 8 feet. In Kansas the earliest date of emergence in the spring is April 6, in Mississippi as early as February 16.

The food consists of various small insects, insect larvae, earthworms, spiders, etc. Small vertebrates such as young lizards and mice are sometimes eaten.

Problems. The chief problem presented by the species is the correlation of the extensive data on life history and habits, and a comparison with similar data for the other two species of five-lined skinks. It is difficult at present to utilize much of the published data on "*E. fasciatus*" because it is not known to which of the three species the data should apply. Comparative studies in natural history can be expected to yield interesting results.

References. Burt, 1928, pp. 61–62, food (*Kans.*); Cagle, 1940, pp. 227–233, figs. 1–12, eggs and young (*lit. cit.*); Conant, 1938, pp. 28–32, habits, eggs (*Ohio*); McCauley, 1939, pp. 93–95, young and eggs (*lit. cit.*); McClellan, Mansueti, and Groves, 1943, pp. 24–25, pls. 5, 6, natural history (*Md.*); Noble and Bradley, 1933, pp. 76–80, courtship (*lit. cit.*); Noble and Mason, 1933, pp. 1–29, breeding habits (*lit. cit.*); Taylor, 1936, pp. 188–212 (*gen. lit.*).

Floridan Five-lined Skink *Eumeces inexpectatus* Taylor

(Pl. 94)

Range. Florida and the keys northward along the coast to southern Virginia, and westward to eastern Louisiana and northern Mississippi. Type locality—Citrus County, Florida. (Map 28, p. 503.)

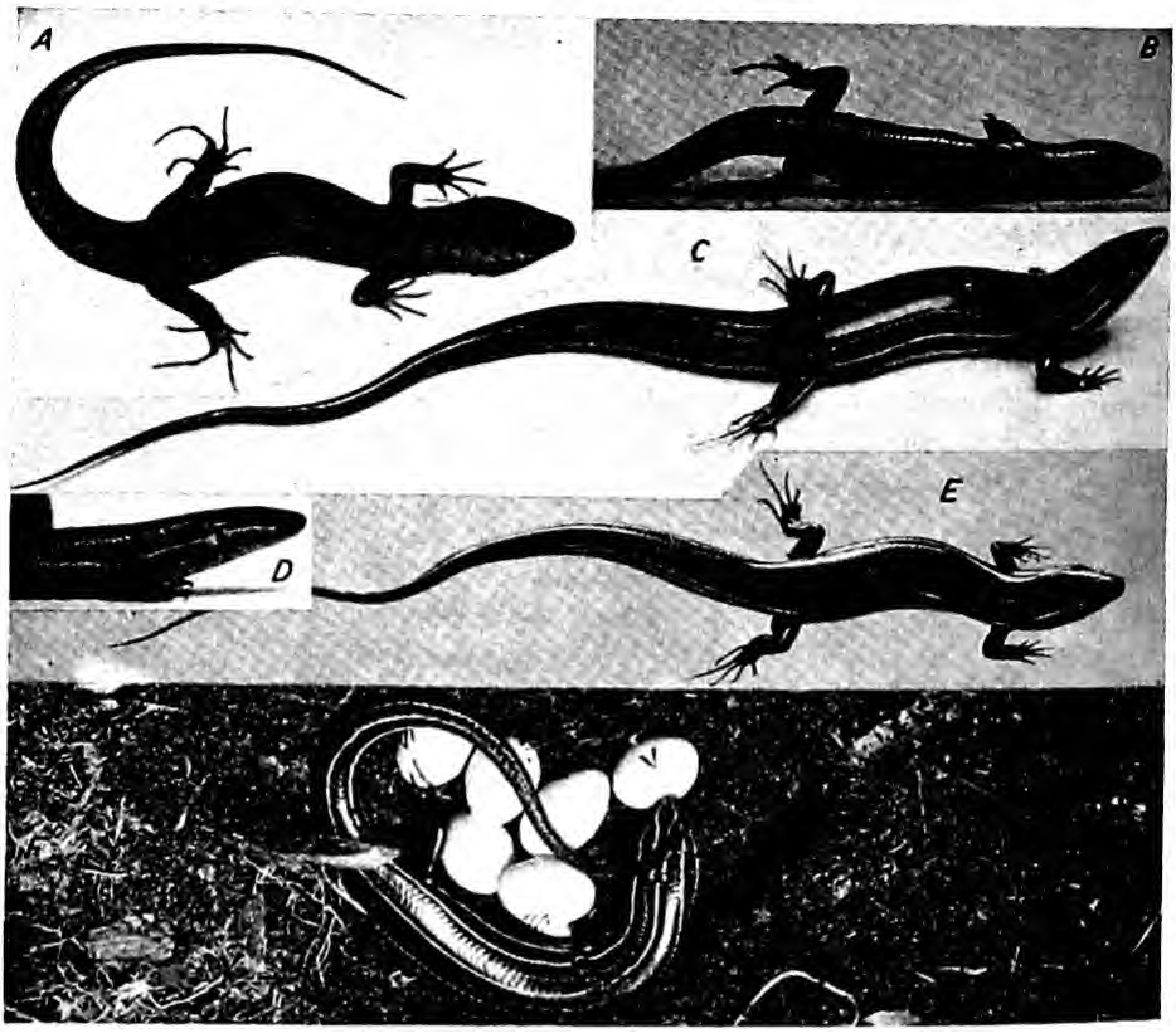
Size. The largest specimen recorded, a male, measured 89 mm. (3½ in.) from snout to vent. The tail is from 1½ to 2 times the head-body length. The limbs overlap when adpressed.

Color. As in the common five-lined skink, with a median, 2 dorsolateral, and 2 lateral light lines in the young. Also present is a sublateral light line, frequently not very prominent, extending from below ear to arm, and from axilla to groin. The light lines, especially the dorsolateral, may be very narrow. The dorsolateral line extends along the fifth, or the adjacent edges of the fourth and fifth scale rows.

The ground color is black above on the body in young specimens, but as greater size is reached, light brown areas form in the paravertebral dark bands, expanding until only a narrow black line borders the light stripes. The lateral dark band becomes gradually lighter, but remains dark long after the remainder of the back has become uniform brown; this and the lateral light line disappear. Females retain, more or less, the subadult pattern; the head loses its stripes but the other five stripes remain more or less distinct. The sublateral light line is lost early in life, as is the blue color of the tail.

Scalation. Postnasal present; 2 postmentals; supralabials 7 or 8; postlabials 2, moderate size. Scales around middle of body 29 to 36, but usually 30, 31, or 32. Median row of subcaudals, near base of tail (on original tail only not regenerated portions), not enlarged or only very slightly. Intercalated row of lateral scales on fourth toe not reaching the third phalanx.

Recognition Characters. The three species of five-lined skinks are distinguished by their pattern and the presence of a postnasal and 2 postmentals.



Pl. 94. *Eumeces inexpectatus.* A, B, D, Eustis, Florida. C, E, Lake Jessup, Seminole County, Florida. U.S. Fish and Wildlife Service photographs. F, Ft. Myers, Lee County, Florida. Courtesy of Arthur Smith and Robert McCauley.

The Florida species is distinguished by the unique character of the median row of subcaudals, which is not widened; in the other two species they are distinctly widened. The Florida species also has the dorsolateral light lines placed on the fifth or fourth and fifth scale rows; in the common and giant species it is placed on the third and fourth or the fourth only.

Habitat. As in the other five-lined species.

Habits. Rather ubiquitous, found in trees or on the ground. In Florida Carr says it is "less arboreal than *laticeps* and a swifter runner on bare ground. Often found under logs and boards in dry sand. I once saw two individuals on a fallen pine log a few feet above the water in the middle of a flatwoods pond; I caught one of these, but the other jumped from the log into the water and apparently went to the bottom. I waited ten minutes or so, but it never reappeared."

In view of the differences between McCauley's and Noble and Mason's

measurements of eggs and young of *laticeps*, it is suggested that perhaps Noble and Mason's material, referred to *laticeps*, actually represented *inexpectatus*. If so, their data are the only known on the Florida species. Differences in eggs and measurements of the young are evident between each of the three species.

Problems. The natural history of this species is well worth investigation, as an aid to a comparative study of the three five-lined species.

References. Carr, 1940, pp. 76–77 (*Fla.*); McCauley, 1939, pp. 93–95 (*lit. cit.*); Noble and Mason, 1933, pp. 1–29 (*lit. cit.*); Taylor, 1936, pp. 224–234, pl. 16, figs. 31, 32 (*gen. lit.*).

Greater Five-lined Skink *Eumeces laticeps* (Schneider)

(Fig. 108, p. 344; Fig. 110, p. 344; Pl. 95)

Range. Central Texas, southwestern Missouri, southern Illinois, central Indiana and Ohio, and extreme southeastern Pennsylvania south and east to the coasts. Type locality not stated. (Map 27, p. 502.)

Size. Very large in comparison with other United States skinks, reaching a maximum snout-vent length of about 130 mm. ($5\frac{1}{16}$ in.) in males; the females are somewhat smaller. The tail is about $1\frac{1}{3}$ to $1\frac{1}{2}$ times the snout-vent length. The limbs overlap when adpressed.

Color. The young are colored much as the common five-lined skink except that, at least in eastern specimens, an extra, sometimes rather poorly defined, light line extends from axilla to groin, and forward on the neck; this is bordered above by a uniform black stripe in turn bordered above by the typical lateral light stripe, and below by an area blending with the belly color. The dorsolateral light stripes tend to run along the fourth scale row only, instead of the edges of the third and fourth. The lateral stripe is regularly placed obliquely on the head, involving all the superior anterior border of the ear opening, but emerging posteriorly from the middle. The same sort of color change with increase in size and age occurs in this as in the common species. The extra lateral light stripe very quickly disappears. The difference lies in the fact that the giant species reaches a much greater size and thus carries the loss of pattern still further. Adult males are a uniform light brown above and even on the sides, with the edges of the scales darker. The dark band between the dorsolateral and lateral light stripes is retained longest, as in the common species, but even this is lost in the largest specimens. The head becomes yellowish or orange.

Large females retain evidence of the light stripes throughout life, although they are dim in the largest species.

Scalation. See Fig. 108. A postnasal regularly present; 2 postmentals; supralabials 7 or 8, but more frequently 8; tertiary temporal frequently in contact

with last labial, completely enclosing lower secondary temporal behind; no postlabials, or 1, or 2 very small ones. Scales around middle of body 28 to 34, generally 30 or 32. Median row of subcaudals very distinctly widened. The

Pl. 95. *Eumeces laticeps.* A, Stove Lake, near Turrell, Arkansas. U.S. Fish and Wildlife Service photograph. B, Bolivar, Tennessee. Gloyd Photograph. C, Waverly Mills, South Carolina. D, Thomson, Georgia. Gloyd photograph. E, F, Waverly Mills, South Carolina.

intercalated, lateral row of scales on the fourth toe extends onto the third phalanx (Fig. 110).

Recognition Characters. The three five-lined skinks are differentiated from all other eastern skinks by having 2 postmentals, a postnasal, and 5 light lines. The most infallible character for separating the giant five-lined from the

common and Florida species is the peculiar conformation of the postlabials and tertiary temporals: it is the only one of the three with greatly reduced postlabials or none at all. The large size is also characteristic, as any specimen measuring over 90 mm. snout to vent almost certainly is the giant species; but of course size is of no value in distinguishing small specimens. Another character, less easily checked but equally reliable as the nature of the postlabials, is the extension of the lateral scale row on the fourth toe as far as the third phalanx. In the Southeast and East very young specimens have 7 light lines (the common species has only 5), and in the same territory the scale rows are usually 32, while the common species usually has 28 or 30.

Habitat. These large skinks live in much the same sort of territory as the common species, but tend to remain in trees more than the latter. On occasion they are found on the ground.

Habits. Much as in the common species except that, as stated above, they are more arboreal. Mating occurs in April and May in Florida; "at this time the males fight on sight and may be heard at long distances chasing one another up and down the trunks and over dry leaves. . . . The rapid copulatory vibrations produced a rasping sound audible forty feet away" (Carr). Blanchard has recorded finding 10 eggs (probably of this species, but not certainly) in a hollow 15 feet from the ground in a tree. The eggs were guarded by two females. An enormous clutch of 27 eggs, guarded by one female, is recorded by Cook for *fasciatus* in Mississippi. It was probably laid by several females. Clutches of from 6 to 10 eggs have definitely been recorded for this species. In Maryland oviposition occurs in late June and the first half of July. McClellan gives an interesting account of a female which showed no inclination to brood her infertile eggs.

The eggs when laid measure about 15 x 10 mm., and near hatching time measure about 20 x 14 mm. Upon hatching the young measure from 30.5 to 32 mm. snout to vent.

McClellan believes shedding occurs once for every quarter inch of growth.

McIlhenny gives an interesting account of how a large five-lined skink (species not certain) shakes small wasp nests to free the larvae and pupae from their cells, scattering them about on the ground. It would even climb vines to do this and then crawl down the vines and hunt for the insects that were scattered about. The adult wasps were not very pugnacious, but several that did attempt to sting the skink were unsuccessful, the sting apparently being incapable of penetrating between the scales; some were snapped at and eaten as they attempted to fight the intruder.

Problems. Aside from the natural history of this interesting species, which as usual is very inadequately known, there is a very interesting problem of geographic variation. In all probability two or more races may be recognizable in the giant five-lined skink, for there are numerous differences between eastern and western specimens. The latter, for instance, more frequently have

30 scale rows instead of 32, the tertiary temporal seldom encloses the lower secondary temporal, and the young are 5-lined instead of 7-lined.

References. Blanchard, 1922, pp. 7–8 (*Tenn.*); Carr, 1940, p. 76, habits (*Fla.*); Cook, 1942, pp. 15–16 (*Miss.*); McCauley, 1939, pp. 93–95, eggs and young (*lit. cit.*); McClellan, Mansueti, and Groves, 1943, pp. 35–42, pls. 6–9, natural history (*Md.*); McIlhenny, 1937, pp. 232–233 (*La.*); Noble and Mason, 1933, pp. 1–19, breeding, eggs (*lit. cit.*); Taylor, 1936, pp. 212–224 (*gen. lit.*).

The Short-lined Skinks—Brevilineatus Group

The name of "stone skinks" is probably a misnomer, or so appears, for in Texas, where two of the species are common, they are more frequently found on flat plains, in pack-rat nests, or under debris, where no stones are to be found for miles. Because of this discrepancy the term is not adopted here; more appropriate is the "short-lined" group. Three species, all of which occur in this country, are included. The group is characterized by a pattern of 5 light lines at least on the head in the young, but the median line disappears in adults; the lateral and dorsolateral light lines tend to be short or narrow and broken. The species give the impression that they are trying either to develop a 4-lined pattern from the old 5-lined type, or to lose the pattern entirely. There is no postnasal (Figs. 113, 115), and usually 1 postmental (as in Fig. 99). The scale rows vary from 24 to 28 at the middle of the body.

Short-lined Skink *Eumeces brevilineatus* Cope

(Figs. 114, 115, p. 345; Pl. 96)

Range. Southern and central Texas from the Great Bend region of the Rio Grande east to about Long. 98° W., southward in northern Mexico. Type locality—Helotes, Bexar County, Texas. (Map 28, p. 503.)

Size. Moderate; the largest recorded specimen measures 66 mm. (2⅝ in.) snout to vent. The tail is about twice the head-body length, or a little less. The limbs are rather weak; when adpressed they touch in young specimens but are somewhat separated in adults.

Color. Olive green to olive brown above; a short, dorsolateral, light stripe extending from the superciliary region (rostral in young) onto the shoulders, disappearing above the foreleg; a broad light stripe, less distinct in adults, involving the supralabials and passing posteriorly through the ear, disappearing on the sides of the neck or, in young, above the axilla. No median light stripe on body. In adults, a faint indication of bifurcating lines on the head; in young specimens these lines are distinct, joining the dorsolateral light lines on the prefrontal, and bifurcating on the anterior nuchals and posterior part of the interparietal; in these the single median line does not extend posterior to the 2 pairs of nuchals.

Pl. 96. *Eumeces brevilineatus*. A, D, Brewster County, Texas. Courtesy of E. H. Taylor. B, Helotes, Texas. C, E, San Antonio, Texas.

Chin and chest cream; remainder of belly bluish.

Scalation. See Figs. 114, 115. Scale rows around middle of body 24 to 28; dorsals from occiput to base of tail 54 to 60; no postnasal; 1, rarely 2, postmentals.

Recognition Characters. The presence of distinct, short, light lines on the head and neck, including at least some evidence of bifurcating light lines on the head (sides of frontal) is distinctive of this species and will separate it from all others of the United States. The species most closely resembling it are *taylori* and *callicephalus* which have 2 postmentals; the former also lacks very clear light lines, and the latter has a distinct lateral dark stripe.

Habits and Habitat. According to Taylor,

> this species is apparently much less shy than *tetragrammus*. Most of the specimens I have collected have been seen moving about in daytime. At Helotes the specimens were usually seen along the small gullies which empty into Helotes creek. They would take refuge in masses of leaves or brush and were usually near pools of water. At Alpine, in Brewster county, they were captured from piles of rotting brush along the edge of a tiny stream fed by a spring. Some escaped by entering the water, diving and entering piles of brush which were in the water. Specimens captured near Sabinas Hidalgo in Nuevo León were in rotting piles of brush, formerly the "nests" of pack rats. At Somerset, Atascosa county, Texas, the species was observed about large plants of *Opuntia* and some were captured with the assistance of Mr. A. J. Kirn by removing the large spreading cacti and digging about among the roots.

Problems. An Oklahoma record of the species (Caddo County) is not impossibly correct, although it needs verification. The life history is not known.

Reference. Taylor, 1936, pp. 283–290, pl. 22, figs. 41–43 (*gen. lit.*).

Mountain Skink *Eumeces callicephalus* Bocourt

(Figs. 112, 113, p. 345; Pl. 97)

Range. Extreme southeastern Arizona southward along the Sierra Madre Occidental to Michoacán. Type locality—Guanajuato, Mexico. (Map 26, p. 501.)

Size. Moderate; the largest specimen recorded measured 65 mm. (2$\frac{9}{16}$ in.) snout to vent. The tail is about twice the head-body length, or a little less. Limbs rather weak, not touching when adpressed, even in young specimens.

Color. General dorsal color olive gray, slightly darker at the centers of the scales. A dorsolateral light stripe extending from superciliary region to about the middle of the body, where it disappears; it lacks a dark median border, but is bordered below by a rather broad, dark brown band extending to base of tail and involving 1 full and 2 half scale rows to 2 full and 2 half rows. The lower edge of this dark stripe is fairly well defined, bordered by a light line

Pl. 97. *Eumeces callicephalus.* A, B, Chihuahua, Chihuahua. C, D, Huachuca Mountains, Arizona. Courtesy of E. H. Taylor.

or not. Supralabials white or cream, this color extending to the ear, and there replaced by the bluish color of the lateral light stripe. The lateral light stripe extends to the groin and becomes indistinct as its narrow, darker, lower border disappears in large specimens. A dim, median, light stripe may be discerned on the neck, bifurcating on the nuchals and passing anteriorly to the rostral; this is very poorly defined in adult specimens, and not all visible posterior to the shoulders. Sides, below lateral dark stripe, and belly bluish; chin cream.

Scalation. See Figs. 112, 113. Scale rows 26 to 28 at middle of body; usually no postnasal in United States specimens; 2 postmentals.

Recognition Characters. The dim light lines, the absence of a median light line on body behind shoulders, and the distinct lateral dark line distinguish this species from others of the genus in the United States.

Habits and Habitat. Gloyd "obtained one specimen and saw another at an altitude of about 6400 feet among loose rocks on the north side of Ramsey Cañon, Huachuca Mountains, July 10, 1931." The species is apparently a high-elevation form.

Problems. The United States specimens very possibly belong to a race distinct from the southern Mexican specimens, as pointed out by Taylor; they usually lack postnasals, whereas Mexican ones usually have them, and there are differences in pattern. If found to be consistently different from Mexican specimens, the United States race will need a new name.

The life history is unknown.

References. Gloyd, 1937, pp. 99, 116 (*Ariz.*); Taylor, 1936, pp. 290–298, pl. 23, text figs. 44, 45 (*gen. lit.*).

Four-striped Skink *Eumeces tetragrammus* (Baird)

(Fig. 12, p. 62; Pl. 98)

Range. Extreme southern Texas south to extreme northern Veracruz. Type locality—Lower Rio Grande. (Map 26, p. 501.)

Size. Moderate; the largest specimen recorded measured 71 mm. snout to vent (2 13/16 in.); the tail is about 1 2/3 times the head-body length. The limbs are moderate, overlapping in young specimens but separated somewhat in large adults.

Color. Olive or olive gray above, becoming somewhat bluish in color on the sides. On head a pair of lines, representing the bifurcated anterior ends of the middorsal light stripe, extending from each side of rostral to the frontoparietal; these are visible in young specimens but disappear completely in subadult and adult specimens. A dorsolateral light line extends from the superciliary region along the fourth scale row to the base of the tail; it is a rather feeble stripe, not dark-bordered, and is broken at the posterior edge of

practically every scale. A similar lateral light line extends from the labial region through the ear, above the arm and along the seventh scale row to the rump, where it disappears. In young specimens the sides between the dorsolateral and lateral stripes are darker than the middorsal region, but in older specimens there is no difference. There is practically no dark color below the lateral light stripe; there is enough to differentiate the line from the light belly color. The belly is somewhat bluish, the chin and gular region cream. In young specimens the tail is azure blue, but with increasing age the tail becomes slate-colored, like the body. The head becomes somewhat reddish in large specimens.

Scalation. No postnasal; temporals typical; 7 supralabials, last largest; either

Pl. 98. *Eumeces tetragrammus.* Near San Juan, Hidalgo County, Texas. Maas photograph.

1 or 2 postmentals; parietals not enclosing interparietal; 2 or 3 pairs of nuchals. There are 26 to 28 scale rows at the middle of the body, and 53 to 59 dorsals from the interparietal to the base of the tail.

Recognition Characters. The absence of any indication of a median light stripe on the posterior part of the body (even though it may be present anteriorly), the presence of narrow lateral and dorsolateral light lines *that lack dark borders* and extend the full length of the body, the absence of a postnasal, and the separation of the parietals behind the interparietal identify this species and separate it from all others in the United States; but *all* these characters must be true. Within its range only two species can be confused with it: the short-lined skink and the southern prairie skink. The latter has dark lines bordering the dorsolateral light lines, which extend onto the tail; there is usually some evidence of a median light stripe on the body. The short-lined skink has shorter light lines, which do not reach the posterior part of the body; some care must be used in comparing with this skink to be sure the full length of the light lines is clearly discerned.

Habits and Habitat. Taylor says, "I have usually found this species when tearing up the large 'nests' of pack rats. They appear to be especially secretive. I have never seen a specimen moving about above the ground. It may probably be that the species is somewhat nocturnal." One has been reported to have

been found under a log. Near Rio Grande City I saw several specimens, of which I captured but one, under the side walls of a fallen house in a section remote from other habitations. In Mexico one was found by excavating the earth that had accumulated in the bottom of a cement pit.

Reference. Taylor, 1936, pp. 298–304, map fig. 46 (*gen. lit.*).

The Lineless Skinks—Obsoletus Group

One American and three Asiatic forms belong to this group. The chief peculiarity of all forms is the black color of the young, which have no light lines or only broken ones. The size is large.

Sonoran Skink *Eumeces obsoletus* (Baird and Girard)

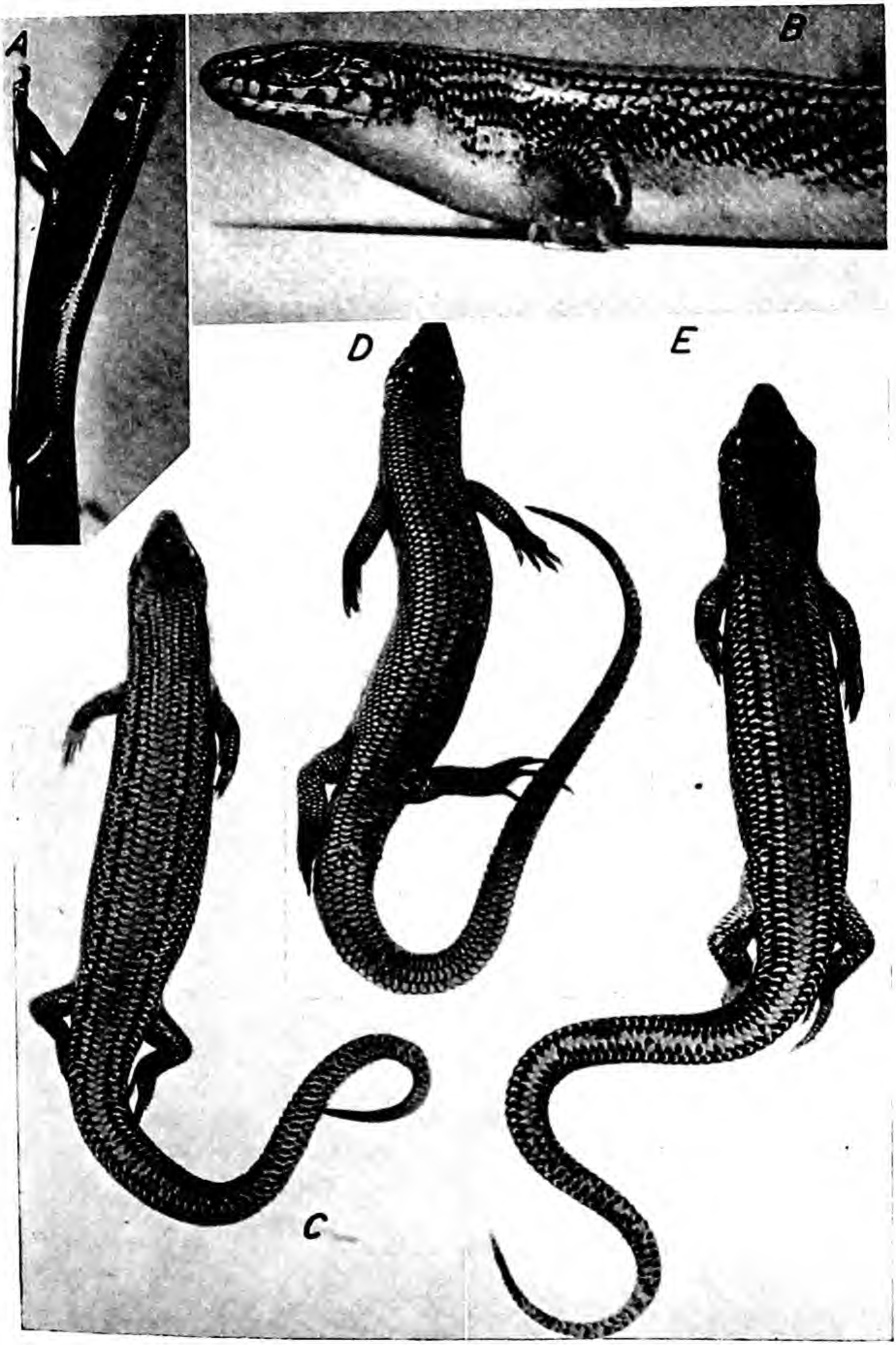
(Fig. 100, p. 341; Pl. 99)

Range. Extreme eastern Kansas and southwestern Iowa southward through the southern corner of Texas to northern Mexico, westward through Colorado and New Mexico to central Arizona. Not recorded definitely from Nebraska, Missouri, Arkansas, or Utah, although probably occurring. Type locality—Valley of the Rio San Pedro of the Rio Grande del Norte, Texas. (Map 29, p. 504.)

Size. This is a large skink, the maximum snout-vent measurement about 125 mm. (4⅞ in.). The tail measures about 1½ times as much as the head and body. The limbs are about equal, the hind leg about ⅓ the snout-vent length. The head may be considerably widened in the temporal region.

Color. The ground color is light slate gray. Perhaps the most frequently encountered adult pattern is a dark brown or black edge about each dorsal scale, lateral to a position a little above a line between the two legs. In some specimens these markings are absent, the lizard being practically a uniform gray above. In others the dark pigment collects between certain longitudinal scale rows, thus producing a somewhat livid pattern. In such specimens the two median scale rows have no dark linear marks but tend to form a median light stripe. The ventral surfaces and the head are largely unmarked. Some reddish coloration may develop in the temporal region in large males.

The young are very different in coloration—so different, in fact, that for years they were thought to be a separate species, called *guttulatus*. At hatching they are jet black all over the body, with the tail a vivid blue; each dorsal plate on the dorsal surface of the head, except for the median scales, each labial, upper and lower, and each mental plate with a conspicuous, round, bluish-white or orange spot occupying all but the outer border. The spots on the dorsal surface are orange, the others white, in life. The effect is that of 3 rows of spots on the side of the head and 1 on each side of the chin. The middle lateral row, or that on the upper labial, is continuous backward with a large spot in



Pl. 99. *Eumeces obsoletus.* A (young), B, C, E, Lawrence, Kansas. D, Cameron County, Texas. C, E, courtesy of E. H Taylor.

front of the ear and with another, extending posteriorly into a point, on the posterior edge of the ear. There are traces of similar spots on the other cephalic plates, but much less distinct.

"With advancing age the ground color becomes more olivaceous, paler beneath, each upper scale with a posterior margin of darker olive very well defined. These characters continue until the specimen is 75 mm. long head and body . . . , the spots on the chin only disappearing in the pale olivaceous green of the under parts" (Cope).

Scalation. The most important feature in this skink is that the scale rows on the sides of the body are diagonal in position, converging posteriorly toward the dorsal surface (Fig. 100). There are 25 to 30 rows about the middle of the body.

Recognition Characters. There is no other smooth-scaled legged lizard in the United States with diagonal, lateral, scale rows. The only other species of skink with a similar feature is found in the Bermuda Islands (*Eumeces longirostris*). In Arizona it occurs in the same area as *g. gilberti,* which is stripeless in the adult stage as is *obsoletus.* See the discussion of *g. gilberti* for comparisons.

Habitat. In eastern Kansas, where these lizards seem to reach their greatest abundance, they are found most commonly on grassy hillsides underneath loose, flat, limestone rocks. In similar topography their range extends eastward into wooded areas. In the West they occur in rocky habitats, "in crevices of rocks and under logs, under the bark of fallen trees, and in bushes. Several specimens were found between the dry dead leaves of sotol" (Mosauer). They occur at elevations as great as 6800 ft.

Habits. These are diurnal lizards, but their habits are secretive so that seldom are specimens seen in the open. Sometimes they are found slinking about on the ground near cover. Probably they wander more frequently than would appear. They may be found in late March, disappearing in hibernation in early October. They hibernate in burrows in the ground, at a depth as great as 10 inches.

Sonoran skinks are among the most vicious lizards of the country. They do not tame well and are likely to snap at almost any time. The bite is rather painful, for the small pointed mouth grabs only a small piece of skin and the jaws are extraordinarily powerful. With a piece of skin in its mouth, the skink hangs on a few seconds, even if allowed to dangle free, and loosens its hold only after giving a final hard pinch and wiggling energetically. If they are forcibly removed, they attempt to twist free and cause a very painful laceration.

Copulation occurs from late April to the middle of June, and may last 4 or 5 minutes. The male grasps a fold of skin at the side of the neck of the female and curves his body sideways beneath that of the mate.

Eggs are laid from the middle of June to middle July. Seven to 15 eggs are

deposited. The female may remain with the nest, which is frequently in a small hollow in earth underneath a stone. The eggs measure about 10 to 12 x 14 to 18 mm. (average 11 x 16 mm.) when laid, and hatch in late August.

The food consists of numerous kinds of insects, insect eggs, insect larvae, spiders, and sometimes small lizards. A male has been recorded eating an egg of the same species—a good reason for the brooding habit of the female if in fact she does not eat the eggs. Ground beetles and lady beetles are rejected. Young specimens are said to lift the blue tail and wave it in sinuous curves as they approach insect prey.

Problems. Taylor gives some reasons for belief that the Sonoran skink may have two or three races. Further studies of the life history and habits are much to be desired.

References. Cope, 1900, pp. 645–650 (*gen. lit.*); Mosauer, 1932, p. 10 (*N.M.*); Taylor, 1936, pp. 305–320, pl. 24, figs. 47, 48, map (*gen. lit.*).

The Narrow-lined Skinks—Multivirgatus Group

Six species represent this group, distributed over central United States and western Mexico. Three forms occur in this country. All are small species, with rather short limbs (touching only at times in the young, widely separated in adults); there is no median light line (except in *multivirgatus*), and the dorsolateral light lines are very narrow, reduced, or absent.

Two-lined Skink *Eumeces gaigei* Taylor

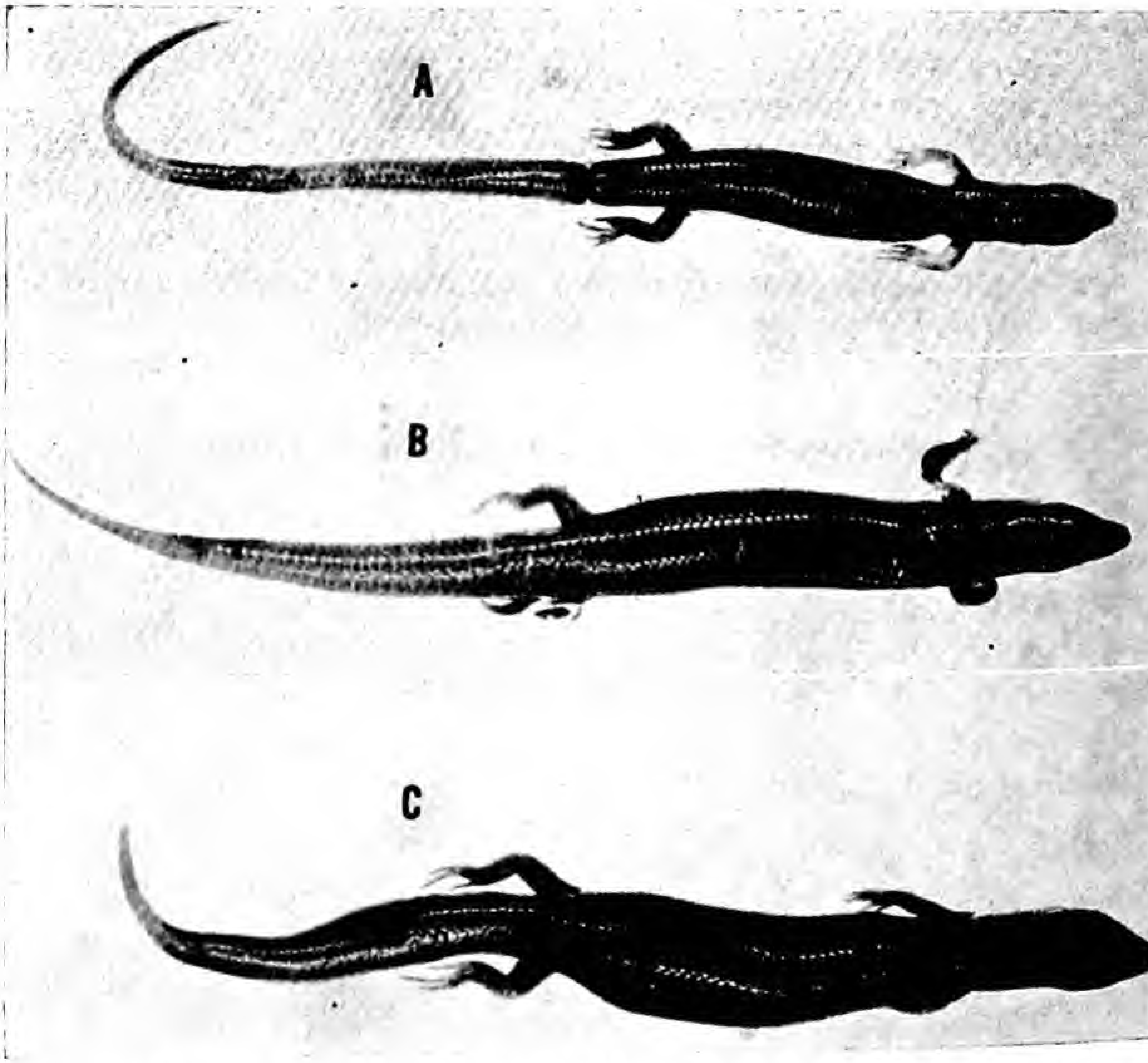
(Pl. 100)

Range. New Mexico from Taos (near northern central border) to extreme western Texas, westward nearly to the Arizona border in the south. Type locality—Taos, New Mexico. (Map 26, p. 501.)

Size. The largest specimen recorded measures 68.5 mm. (2¹¹⁄₁₆ in.) from snout to vent. The tail is probably about 1⅔ times the head-body measurement in adults, but this is not certainly known; in very young specimens it is only about 1⅕ times the head-body length. The limbs are rather short and do not meet when adpressed.

Color. In adults, the ground color is olive brown. There is no median light line either on the head or the body. The outer edges of the scales of the first and second scale rows are of a darker brown color that forms a dim line following the adjacent edges of the first and second rows, and of the second and third. The dorsolateral light line is distinct and follows the middle of the third scale row, the rest of which is dark brown; the line may be continuous or appear as a series of dots; a narrow dark brown lateral band is present, beginning at the eye, and passing along the adjacent edges of the fourth and

fifth scale rows; it is bordered above and below by dotted lines of ground color slightly lighter than that on back. A light labial line passes above the ear but then stops. A light lateral line begins at the ear, passes posteriorly above the arm, and then disappears. The chin, throat, anal region, and ventral surfaces of the limbs are cream, and the belly is bluish gray.



Pl. 100. *Eumeces gaigei.* A, Frijoles, Guadalupe Mountains, Texas. B, C, Taos, New Mexico. All females. Courtesy of E. H. Taylor.

A young specimen is colored much like the adult except that the dorsolateral light lines are yellow; there are a few lighter flecks along the median scale rows on the body, but these do not indicate a light line. The tail presumably is blue (see Taylor).

Scalation. Postnasal variable, present, or absent; 2 postmentals; 7 supralabials; parietals not enclosing interparietal posteriorly. Scale rows around middle of body 24; scales from parietals to base of tail, 61 to 62.

Recognition Characters. The dorsolateral light stripes, extending the full length of the body and restricted to the third scale row, characterize the many-

lined and two-lined skinks, separating them from all other United States species of these smooth-scaled lizards. The two-lined skinks can be separated from their relatives by the complete absence of a median light stripe, both in young and old. The lateral light lines also are absent on the trunk, where only the two dorsolateral light lines are evident.

Habits and Habitat. Near Taos Taylor found two specimens "in barren hills along a stream about a mile from the large Indian village through which the stream flows. They were found under small, flat rocks on a steep hillside, and appeared to be making burrows, as the earth was freshly disturbed; they took refuge in the burrows, which extended three inches below the surface."

Mosauer found another that "was seen, together with several others, slipping through the semiaquatic vegetation along the border of the spring at Frijole, Texas. The high and dense plant growth rendered capture extremely difficult, so that only one of the specimens could be secured. In flight it crossed the tiny stream without hesitating."

Only three other specimens are known, and these are not accompanied by data on habits or habitat.

Problems. As can be inferred from the foregoing discussion, the natural history of this curious species is practically unknown. In view of its close relationship and close association with the many-lined skink, comparisons of the natural history of the two species will be of the greatest interest. There is also a problem in taxonomy involving this species, largely due to the paucity of specimens, since only six are known. The species bears some resemblance to the obscurely marked western specimens of the many-lined skink, yet the young of the two species, it seems, are widely different; those of the many-lined species have a distinct median light line (as do the adults except when discolored) while those of the two-lined skink lack the median stripe completely. Bailey refers a juvenile with a distinct median stripe to the two-lined species; if this is correct, the validity of the species is very dubious. For the present I refer the striped young to *multivirgatus*. Obviously the status of this species and that of the western specimens of the many-lined skink merit a thorough study as soon as sufficient specimens have accumulated to give a clear picture of the situation.

References. Bailey, 1937, p. 96 (*N.M.*); Mosauer, 1932, pp. 12–13, pl. 1, fig. 2 (*N.M.*); Taylor, 1936, pp. 353–358, figs. 55 (map), 57 (*gen. lit.*).

Many-lined Skink *Eumeces multivirgatus* (Hallowell)

(Fig. 97, p. 335; Pl. 101)

Range. Extreme southwestern South Dakota, the western half of Nebraska, southeastern Wyoming, central Colorado, central New Mexico, and the plateau areas of northern Arizona. Type locality—probably Cow Creek, Larimer County, Colorado. (Map 27, p. 502.)

Size. Moderate; the largest recorded specimen measured 73 mm. (2⅞ in.) snout to vent. The tail measures about 1⅔ times the head-body measurement, and appears rather fat proximally and slightly constricted at the base. Limbs rather small, not or but slightly overlapping.

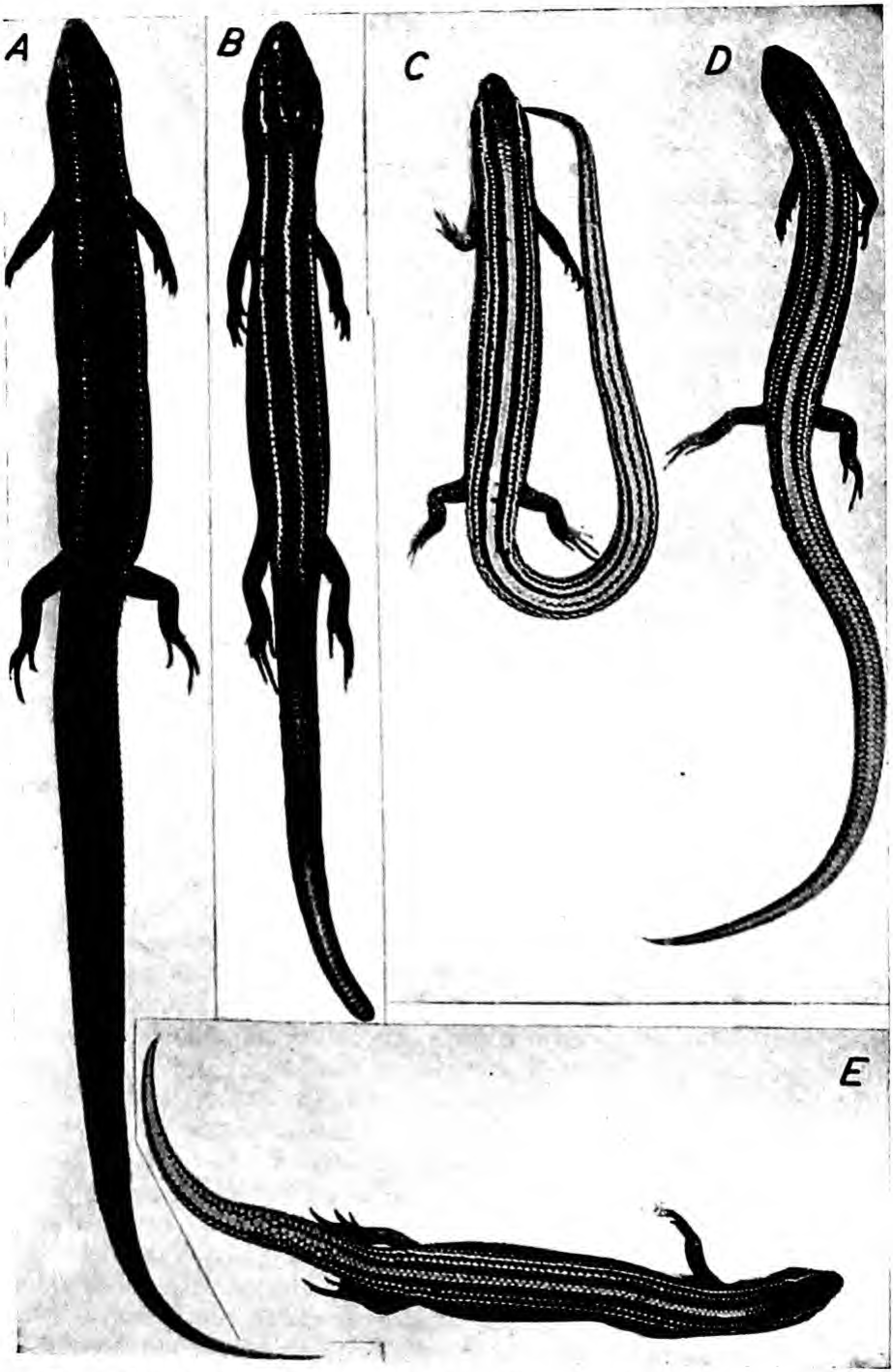
Color. Very variable. Typical adult or subadult specimens from areas east of the Continental Divide have a pattern of numerous, very well defined, alternating, light and dark lines that is very characteristic of the species. There is a broad median light line extending from the head onto the tail; it disappears on the head or divides into 2 lines, never very distinct, that extend to the rostral. This line is bordered on either side by a distinct dark line occupying most of the first and the edge of the second scale row. The remainder of the second scale row is light. The third row is dark, but down the middle of it passes a narrow, continuous, dorsolateral, light line, extending from the superciliaries onto the base of the tail. A broken, light lateral stripe follows the sixth scale row, more or less blending with the light belly color below. The sides between the dorsolateral and lateral light stripes are dark, save for 2 light lines, one on the inner edge of the fourth scale row, the other on the outer edge of the fifth row. The chin is cream, and the remainder of the ventral surfaces are light slate. The tail is of the same color as the light areas on the body and has irregular, dark, longitudinal lines at least near the base. The limbs are dark, the center of each scale light.

In the young the secondary light lines (in other words all except the median, dorsolateral, and lateral lines) are absent. The pattern in these consists of just 4 or 5 light lines; the dorsolateral are very distinct and the lateral lines rather dim; in western specimens (western New Mexico and Arizona) the young have very distinct median lines; in eastern specimens the median light line becomes evident only in adults. The secondary light lines appear with increased size until the bold, many-lined pattern of the adult is reached. The tail in the young is blue or lavender.

Specimens which have been preserved in formalin become greatly darkened; the light areas are particularly affected, and the result is that the stripes become greatly obscured, and the pattern much less bold than in life. Curiously, the dorsolateral light stripes are the least affected of all and remain distinct when the other light stripes can scarcely be discerned.

Scalation. Usually a postnasal present; 7 supralabials (very rarely 6 or 8); usually 2 postmentals; the parietals are separated behind the interparietal (Fig. 97); there are 2 pairs of nuchals. Scales around middle of body 24 to 26, and from parietals to base of tail 61 to 63.

Recognition Characters. The adults, if properly preserved in alcohol, can readily be distinguished from all other United States skinks by the pattern of many dark and light lines. The young specimens, however, and adults darkened by preservation in formalin cannot thus be identified. The peculiar position of the dorsolateral light stripe, restricted completely to the third



Pl. 101. *Eumeces multivirgatus.* A, Chihuahua, Chihuahua. B, Grand Canyon National Park, Arizona. C, D, E, Weld County, Colorado. Courtesy of E. H. Taylor.

scale row, and the length of it, extending the full length of the body, are characters held only by the many-lined and the two-lined skinks. The latter species never has a median light stripe, even in the young (the striped juvenile reported by Bailey is believed to be *multivirgatus,* not *gaigei*).

Habits and Habitat. But little has been recorded.

> Mr. Lewis V. Barry of the Denver Museum has found the species to be common and easily collected in Weld county and in Denver county, occurring in vacant lots in Denver City. . . . He states:
>
> "May 13, 1931, on a trip for rattlesnakes near Milton reservoir in Weld county, we found the first skink. Later the same day four more were collected. These were all found under cow dung in a prairie-dog town, feeding on ant larvae. . . . Near Grover in Weld county a Desert Sparrow Hawk . . . had one of these reptiles in his claws" (Taylor).

A specimen collected by me near Estancia, N.M., was one of several seen running about on the ground from hole to hole in the morning of a relatively cool day. This locality is a high, but semiarid plain. Mosauer found another specimen "in the pine and spruce forest of the plateau region of the southern Guadalupe Mountains."

The species is oviparous. One specimen is recorded with 5 eggs, measuring about 13 x 8 mm.

Problems. The natural history of this species is unknown and merits thorough study; the habitat seems very variable. An interesting problem in taxonomy is the prevailing obscurity of the pattern on Arizona and certain New Mexico specimens (one well-preserved Arizona adult has a typical pattern). I have guessed that it is due simply to the fact that most of them have been preserved in formalin, whereas by chance most of the specimens from more eastern localities have been preserved in alcohol and thus preserve the pattern more as it is in life. This point needs checking upon live western specimens; it may well be that even in life the pattern is obscure, and if so, the western specimens belong to a subspecies distinct from the eastern one. The name *inornatus* Baird, thus far not in common use, seems to be based on specimens like these, although they happen to come from Nebraska, where the typical, distinctly striped specimens normally occur. Nevertheless, the western specimens of *multivirgatus* are probably not of the same race as the eastern specimens, for the young are very strikingly different. It is not impossible that *gaigei* figures in the confusion. I believe the young of the latter species have no median light stripe, and Bailey believes they do. If the latter is correct, then *gaigei* becomes distinguishable from western *multivirgatus* with difficulty, for both apparently would have young identically marked. Yet adult *gaigei* have a pattern different from that of adult Arizona *multivirgatus,* some specimens of which are many-lined like eastern *multivirgatus.* The whole situation needs further study for clarification. Even the Mexican specimen

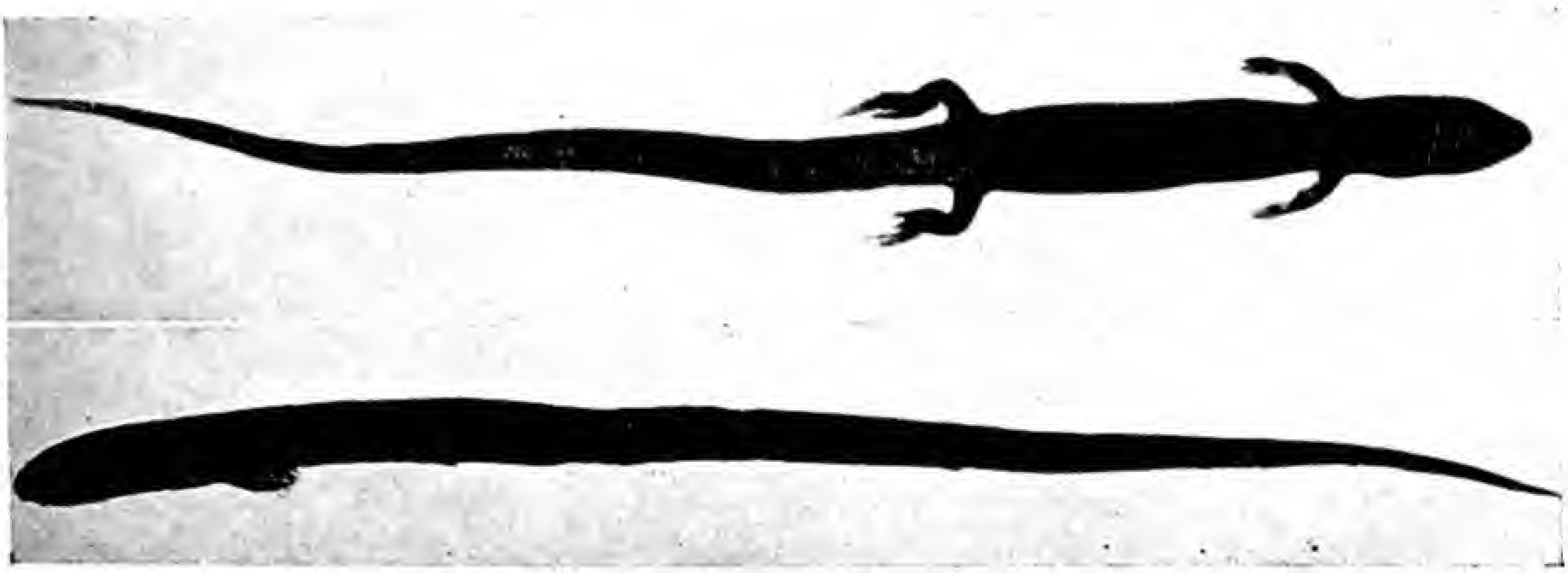
from Chihuahua does not seem the same as United States specimens and is probably a still different form. A further possibility is that *gaigei* is the same as *taylori*.

References. Bailey, 1937, p. 96, the young specimen only (*N.M.*); Mosauer, 1932, pp. 14–15, pl. 1, fig. 1 (*N.M.*); Taylor, 1936, pp. 341–353, pls. 27–28, text figs., 54–56 (*gen. lit.*).

Pecos Skink *Eumeces taylori* Smith

(Pl. 102)

Range. Vicinity of the Guadalupe Mountains of extreme western Texas and adjacent New Mexico. Type locality—near Frijoles, Guadalupe Mountains, 6000 feet, Texas. (Map 28, p. 503.)



Pl. 102. *Eumeces taylori*. Carlsbad Caverns, New Mexico. Courtesy of E. H. Taylor.

Size. The largest specimen known measures 65 mm. (2⁹⁄₁₆ in.) from snout to vent. The tail is 1⅔ to nearly 2 times the head-body length. The tail is rather fat, and the legs rather short, widely separated when adpressed.

Color. Dark olive brown above; a dark streak on sides of head, disappearing on neck or sometimes continuing to groin. No light stripes visible on head or body, except for the white supralabials, even in very young specimens. Chin cream, remainder of ventral surfaces dark, bluish. Young with blue tails.

Scalation. Scale rows at middle of body 24 to 26; scales from occiput to base of tail 61 to 63. Postnasal present; 2 postmentals; prefrontals broadly in contact.

Recognition Characters. The complete absence of light stripes, or very poor definition of them, combined with the presence of 2 postmentals and a postnasal should identify all lizards of this species.

Habitat. Mosauer found two specimens in the Guadalupe Mountains "in humid habitats with rich vegetation." One specimen was found "slipping through the moist vegetation at the margin of the miniature pond formed by

the spring." Taylor found another specimen "in a pile of drift at the edge of Black River, which flows partly above and partly below ground in the Carlsbad region."

Problems. Until further specimens are known of both this and the Mexican *humilis,* from which this was recently separated, the distinctness of the two species cannot be certain. The habits of the species are very poorly known.

References. Mosauer, 1932, pp. 10–12, pl. 1, fig. 3, habits, habitat, description (*N.M.*); Smith, 1942, pp. 93–95, separation of *taylori* from *humilis* (*lit. cit.*); Taylor, 1936, pp. 358–363, pl. 30, figs. 58, 59 (*gen. lit.*).

The Eastern Four-lined Skinks—Anthracinus Group

Four species belong to the group. Only one, *copei,* is extralimital, occurring in central Mexico. All species are of medium size, and have 4 (dorsolateral and lateral) light lines. The median light line is absent or indicated only on the body; it never reaches the head and divides there as in five-lined species. The postmentals are 1 or 2, the postnasal missing. There are 7 upper labials. The limbs are of moderate size, not or slightly overlapping when adpressed to the sides of the body.

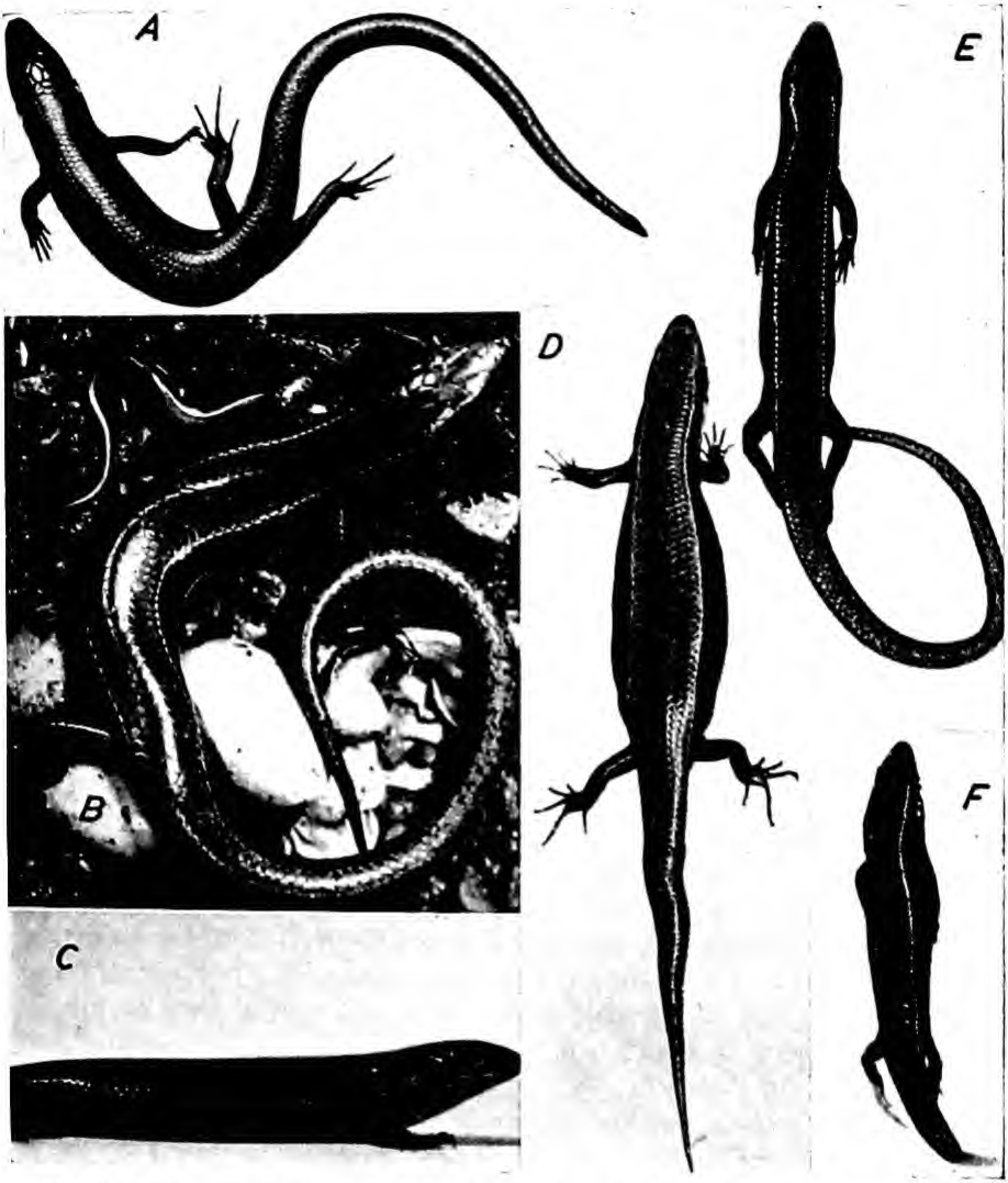
Coal Skink *Eumeces anthracinus* (Baird)

(Fig. 116, p. 345; Pl. 103)

Range. Discontinuous; western New York southward to northern Maryland; western North Carolina; extreme southern Mississippi and Alabama; and from northwestern Louisiana northward through the southern half of Missouri and eastern Kansas south of the Kaw River. Type locality—North Mountain, near Carlisle, Pennsylvania. (Map 30, p. 505.)

Size. The largest specimen recorded has a snout-vent length of 64 mm. (2½ in.). The tail is about twice the head-body length in adults, equal in very young. The limbs overlap when adpressed (except in occasional old females).

Color. Adults olive gray to olive brown above; a narrow dorsolateral white line on each side, originating in superciliary region or posterior corner of eye, and extending onto base of tail; this light line is placed on the adjacent edges of the third and fourth scale rows (counting from middorsum). A broad, rich, dark brown band on sides of body below dorsolateral light stripe, extending from sides of head through upper edge of ear, above the foreleg, through the upper margin of the insertion of the hind leg and onto the tail, disappearing toward the tip. This band occupies 2½ scale rows, and below it, from ear to groin, is a narrow white line occupying only the middle of a scale row on the sides of the abdomen. Below this from the angle of the mouth to the groin



Pl. 103. *Eumeces anthracinus*. A (male), D (female), Imboden, Arkansas. B (female with eggs and young), C (female), Bergen, New York. E, F, Cherokee County, Kansas. Courtesy of E. H. Taylor

is a narrow dark area often scarcely visible, never with a distinct lower edge but fading into the gray or bluish ventral color. Entire ventral surfaces bluish or gray, without dark markings. On the medial border of the dorsolateral light stripes a narrow dark brown streak is present on some part of the body and is sometimes continuous. In some specimens a dim, median light stripe is present on the neck, sometimes extending the length of the body but never

involving the head scales; it is usually bordered on either side by a broken, narrow, dark streak. There are some irregular light spots on the side of the head, the most prominent of which is one on each of the last and next to the last supralabials; these marks are said to be reddish in life in many specimens. The young may be almost uniformly black, with reddish spots about the head, or may have stripes nearly like the adults'; the tail is always deep blue-violet.

Scalation. The chief features of the scutellation of this species are the presence of a single postmental; the absence of postnasals; a scale longer than wide bordering the postgenial medially; median subcaudal scales widened; 24 to 28 scale rows about the middle of the body; 7 supralabials.

Recognition Characters. The only four-lined skinks known from eastern United States as far west as through Louisiana, Oklahoma, Kansas, and the Dakotas are the coal skink and the red-tailed skinks. The latter is a peculiar species, without a primary temporal or a lower secondary temporal, a red tail, only 18 to 22 scale rows, etc. In the West, where a feeble median stripe is characteristic of the coal skink, some confusion with five-lined species, which may lose the median lines on the head as they grow older, is possible; the latter, however, lack a postnasal and have 2, instead of 1, postmentals.

Habitat. Usually found in Kansas and Oklahoma on wooded hillsides in rotten logs, piles of brush and leaves, and under loose stones; more or less humid habitats not removed from water seem to be preferred. In New York they are found in certain areas near swamps and under wood piles or rocks.

Habits. Although usually found in concealment, in both the East and the West specimens have frequently been seen and captured while moving about in the open. They do not hesitate to take to water for protection.

Courtship and mating occurs in late May in New York. Eight or 9 eggs are laid in late June and are guarded in nests by the female. They average 6 x 10 mm. when laid, and after 30 days an eastern batch averaged 11.5 x 17 mm. In about 4 to 5 weeks the eggs hatch, and the newly born young measure from 47 to 51 mm. in total length.

Age groups in snout-vent measurements have been suggested by Taylor as follows: at hatching 21–23 mm.; second year, 26–29 mm.; third year, 30–34 mm.; fourth year, 35–40 mm.; fifth year, 42–46 mm.; sixth year 49–51 mm.; seventh year, 53–56 mm.; eighth year, 56–59 mm.; ninth year, 59–60 mm.; etc. If this is the case, growth in these lizards does not parallel that of the fence lizards, the northern prairie skink, or the common western skink.

The food consists of various small insects and insect larvae.

Problems. Aside from the life history, which still presents interesting and perplexing angles, there are disturbing differences between eastern and western specimens that indicate that these really represent two different subspecies. The young of western specimens lack stripes or have very dim ones, are almost uniformly black, and have red marks about the head, whereas

eastern juveniles are marked much like the adults. Moreover western specimens very frequently show evidence of a median light stripe, while eastern specimens do not. And Taylor remarks, "It appears that, in general, specimens from the southeastern part of the range have somewhat shorter and slightly heavier limbs."

References. Burt, 1928, pp. 49–51 (Kans.); Clausen, 1938, pp. 3–7, figs. 1–2 (*N.Y.*). Gloyd, 1928, p. 120 (*Kans.*); Taylor, 1936, pp. 373–387, pl. 32, text figs. 62–63 (*gen. lit.*).

Northern Prairie Skink *Eumeces septentrionalis septentrionalis* (Baird)

(Fig. 118, p. 346; Pl. 104)

Range. Southern Manitoba south to southern Kansas and northern Oklahoma. Type locality—"Minnesota and Nebraska." (Map 31, p. 505.)

Size. The maximum snout-vent measurement is 32 mm. ($3\frac{1}{4}$ in.); the tail is but little longer than the head and body in young specimens, but becomes almost twice as long in adults. Limbs overlapping (young) or narrowly separated (adults) when adpressed.

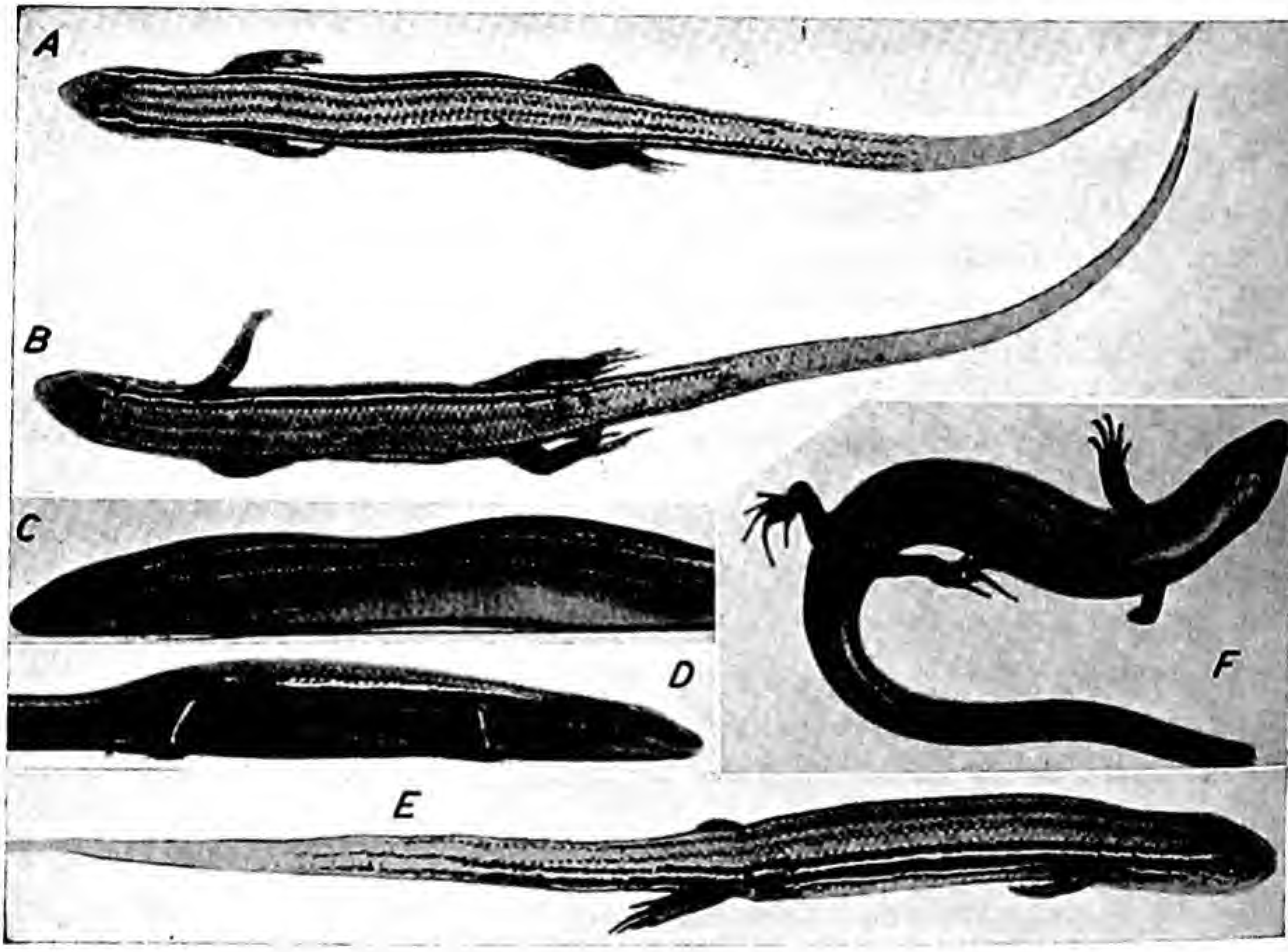
Color. Ground color olive to olive brown. Two primary white lines on either side of body, but no primary median stripe, although a secondary one is usually present. Dorsolateral light line extends from supraocular along the middle of the fourth or adjacent edges of the fourth and fifth scale rows, a considerable distance on tail. The lateral light stripe extends from the supraoculars through the ear, along the seventh or adjacent edges of the sixth and seventh rows, skirting the upper margin of the insertion of the hind leg and onto the tail. Below the lateral line is a narrow dark line, and between it and the dorsolateral line is a broad, dark brown band; bordering the dorsolateral stripes medially is another brown band involving 2 half scale rows; on the adjacent edges of the first and second scale rows, from the nuchal region to the base of the tail, extends another dark brown stripe on each side. These three lines of ground color (not light color as in the primary light stripes) are enclosed by 4 dark bands. In some specimens the paravertebral bands are poorly defined.

The chin is cream, the remainder of the ventral surface bluish. "Males during the breeding season develop a deep reddish-orange coloration on the edge of the lower jaw and the sides of the head in the temporal region. This soon tends to fade out and no trace of the color is left in specimens collected a month later" (Taylor). The tail is bright blue in the young, but the color becomes dull with increasing age, the blue disappearing at a snout-vent of about 50 mm., 2 in. (Breckenridge).

Scalation. See Fig. 118. Scale rows about middle of body 25 to 29, usually 26 to 28; scales from occiput to base of tail 57 to 62, average 60. No postnasal.

Normally 2 postmentals, rarely 1. Frontonasal small, occasionally absent, rarely in contact with anterior loreal.

Recognition Characters. The distinct dorsolateral light lines, extending the full length of the body on the fourth or fourth and fifth scale rows; the presence of 2 postmentals and no postnasal; and the separation of the frontonasal from the loreal will identify specimens of this race. Within the area where they occur the only other species which may be confused with them is the many-lined skink, in which the dorsolateral light lines are restricted to the third row, and the coal skink, which has but one postmental.



Pl. 104. *Eumeces septentrionalis septentrionalis.* A, B, E, Onaga, Pottawatomie County, Kansas. C, F, Lawrence, Kansas, D, Ice Caves, northeastern Iowa.

Habitat. "Open, grassy hillsides where small, flat rocks offer some shelter" (Taylor). They may utilize other cover when available, as about human habitations. In Minnesota Breckenridge determined that sandy or gravelly habitats are preferred to clay and loose soils.

Habits. These lizards are almost always found under some object. Though they are rarely seen moving about in the open, their wariness and ability to effect quick concealment, rather than any nocturnal or burrowing habits, are probably responsible for their apparent scarcity. The distribution is not continuous. Localities that appear perfectly satisfactory may be found lacking

in the species, whereas others, in all appearances essentially identical, may harbor specimens in abundance. So far as I am aware, in only one locality, central Kansas, can the species be spoken of as really abundant.

Mating occurs in May and early June. Five to 13 eggs are laid between the end of May and the middle of July. They are deposited in excavations in moist, loose soil under stones, boards, and other objects. At laying, the eggs measure from 7 to 9 mm. in width, 12 to 15 mm. in length, and average 8 x 13.4 mm. In 40 to 52 (average 45.5) days the eggs hatch. At this time the young measure from 24 to 26.5 mm. snout to vent. In the wild they grow rapidly following the first winter, at an average rate of .37 mm. a day; in the second year the average growth rate is .31 mm. a day, and in subsequent years the growth rate drops off sharply. At the end of the second year mature size (65 mm. or more, snout to vent) is reached.

Among the enemies of this species are hog-nosed snakes, hawks, owls, skunks, raccoons, and ground squirrels. Cannibalism is known, adults sometimes feeding upon the young.

The food consists of small insects, snails, and other arthropods. Orthoptera and spiders comprise a large proportion of the food, but bugs, beetles, and lepidoptera are of frequent occurrence in the diet.

In Iowa fifty-two specimens were found in hibernation on February 15, 4½ feet below the surface of the ground in a gravel pit. They were torpid, but a few became active when placed in a heated room. "In central Minnesota skinks become largely inactive in September, going into permanent hibernation late in October. Males emerge from hibernation late in April or early in May, while the females do not appear until later in May" (Breckenridge).

Problems. The curious distribution, scattered in isolated populations, is most interesting. The reason for it is unknown. A series of specimens from southern Kansas and northern Oklahoma is much to be desired, in order to fix more definitely the identity of the populations that are known (from few individuals) to occur there, and to delimit more precisely, if possible, the area of intergradation between the northern and southern races.

References. Breckenridge, 1943, pp. 591–606, life history (*Minn.*); Scott and Sheldahl, 1937, p. 192, hibernation (*Iowa*); Taylor, 1936, pp. 59–60, 394–405, text figs. 66, 67, pl. 34 (*gen. lit.*).

Southern Prairie Skink *Eumeces septentrionalis obtusirostris* (Bocourt)

(Figs. 117, 119, pp. 345, 346; Pl. 105)

Range. Southern central Kansas south to southern central Texas. Type locality—Texas. (Map 31, p. 505.)

Size. Largest recorded snout-vent length 74 mm. (2 15/16 in.). The limbs are a little shorter than in *s. septentrionalis,* but are otherwise the same.

Color. As in *s. septentrionalis* except that the paravertebral stripes are much reduced or absent, and do not usually extend beyond the shoulders or middle of neck.

Scalation. See Figs. 117, 119. As in *s. septentrionalis* except that the scale rows are usually 28, seldom 26; the dorsal scales from occiput to base of tail 55 to 58, average 57; and the frontonasal usually in contact with the anterior loreal.

Recognition Characters. From its northern relative, *s. septentrionalis,* the present race can be distinguished by the usual contact of the frontonasal with the anterior loreal (usually separated in the other race); dorsal scales 58 or less from occiput to base of tail (59 or more in the northern race); and the reduction of the paravertebral dark stripes. Specimens from northern Oklahoma are intermediate and must be allocated with one or the other race more or less arbitrarily; customarily all Oklahoma specimens are referred to *obtusirostris,* and even certain southern central Kansas ones; although intergrades these approach the averages for the southern race more closely than those of the northern.

The only other *Eumeces* occurring in central Texas and Oklahoma that could be confused with this are *tetragrammus* and *anthracinus,* which have a single postmental, and *brevilineatus,* which has short light lines.

Habits and Habitat. Taylor has found that

this species, like its neighbor, *Eumeces brevilineatus,* frequents the vicinity of large masses of *Opuntia* so common in southern Texas, and usually takes refuge in the sand about their bases, from which places they may be captured only with considerable difficulty. Near Waco, Texas, I captured several specimens from debris about the bases of willow trees in gravel pits. Here they were feeding in company with *Leiolopisma.* In this same locality and association were collected more than one hundred specimens of the small snake *Potamophis striatulus* (Linné).

While collecting amphibians at night about a small pond near Somerset, Texas, two were discovered and captured. They were first observed on a small stump in the edge of the water, and when disturbed took to the water to escape, diving below its surface. It suggests that they may be somewhat nocturnal in habit. To the west of Waco, along the Brazos river, two specimens were taken from leaves and other debris at the base of a large tree.

Problems. Our knowledge of the life history and habits of the race is summarized by the above. Much work remains to be done on it.

Reference. Taylor, 1936, pp. 405–410, pl. 28, text fig. 67 (*gen. lit.*).

The Western Four-lined Skinks—Skiltonianus Group

At present five species and subspecies are recognized in this group, restricted to western United States, Baja California, and British Columbia.

Pl. 105. *Eumeces septentrionalis obtusirostris.* Waco, McLennan County, Texas. Courtesy of E. H. Taylor.

Characteristic of the group is the absence of a median light line and loss of all light lines in large specimens, and the presence of a postnasal (Figs. 105, 106) and of 2 postmentals (as in Fig. 117). The dorsolateral light lines occupy scale rows 2 and 3 on either side, when present.

The taxonomy and variation within the group are very much in need of study. Taylor's treatment (*gen. lit.*) is replete with suggestions that certain series, too inadequate for definite conclusions, appear different from others. No other group in the genus, within this country, offers the interesting distributional and taxonomic problems that this does. Rodgers (*Calif.*) has already contributed a study of one form. While the distinctness of the several recognized forms is unquestionable, in ease of distinction of individual specimens there is much yet to be desired. At the present time a series of specimens is usually required for definite assignment to one form or another, unless locality data are used as an aid.

Common Western Skink *Eumeces skiltonianus* (Baird and Girard) (Pl. 106)

Range. South-central British Columbia southward on both slopes, excluding the range east of the San Joaquin Valley, through northern Baja California, and east to western Utah and western Montana. Type locality—Oregon. (Map 26, p. 501.)

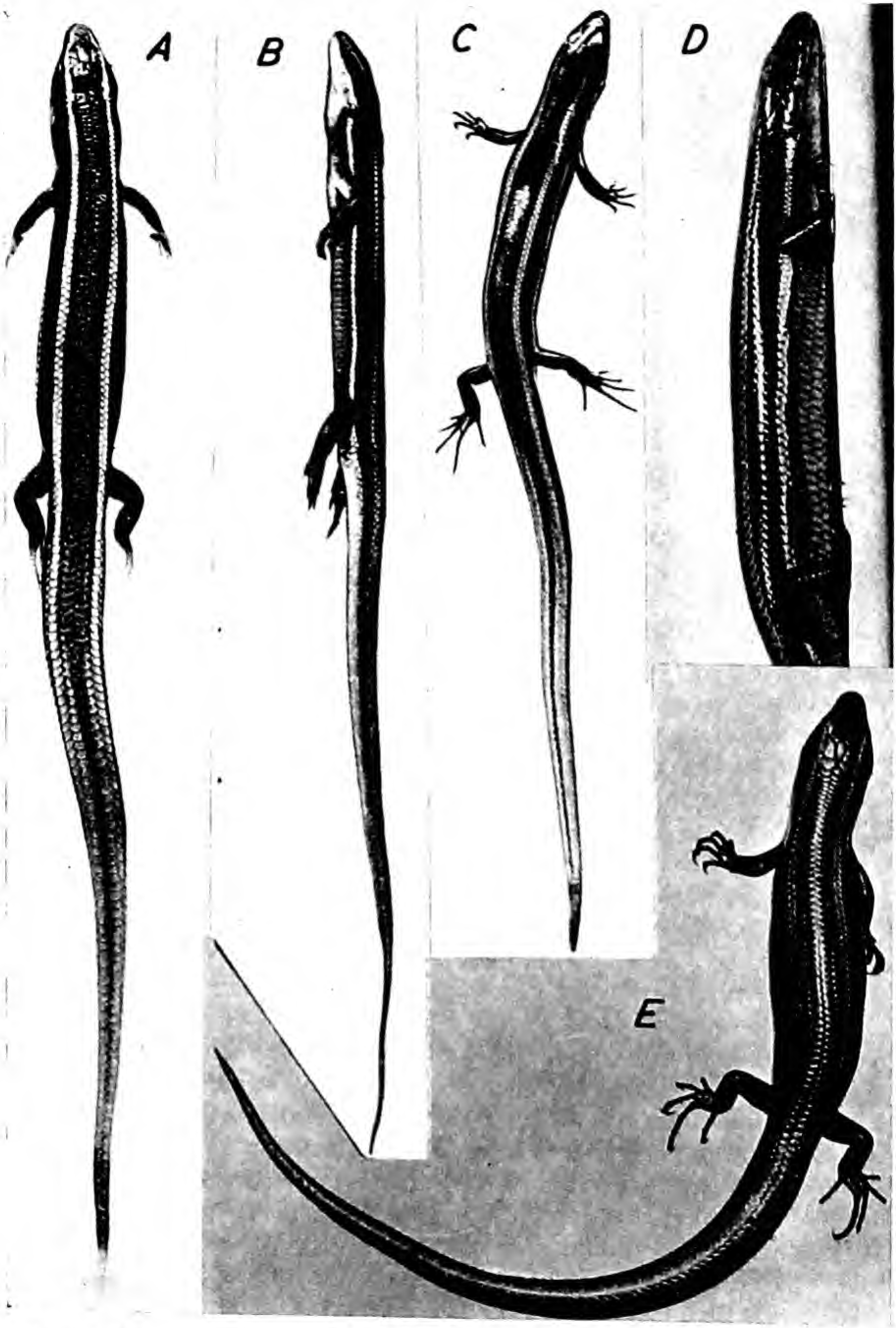
Size. Maximum snout-vent length about 83 mm. (3¼ in.). The tail is from 1⅝ to nearly 2 times as long as the head and body. Limbs well developed, overlapping somewhat or a little separated when adpressed to the body.

Color. Dorsal surface light brown to clay brown; head lighter, somewhat reddish, in adult males. A bold dorsal pattern of 2 broad, dorsolateral, light lines extending from the snout to the base of the tail, involving the adjacent halves or two-thirds of the second and third scale rows; the light stripe is usually edged with dark brown above. A lateral light stripe extends from labial region through ear to groin, involving usually the adjacent halves of the sixth and seventh scale rows, sometimes restricted to the sixth. A dark brown line, sometimes dotted, borders the lateral light stripe below. Between the lateral and dorsolateral stripes is a broad, dark brown, lateral band, extending from the head to a considerable distance on the sides of the tail. The dorsolateral light stripes expand on the tail, crowding out the dorsal and lateral brown ones; most of the tail a uniform light brown. In juveniles the tail is bright blue.

Throat, chest, and ventral surfaces of tail and hind legs cream, belly bluish.

Even in old specimens this pattern is retained, perhaps becoming only a little less distinct than in the juveniles. The breeding males may develop a reddish suffusion in the temporal region, but the color is transitory.

Scalation. Scale rows around middle of belly 24 to 28, usually 26; dorsal



Pl. 106. *Eumeces skiltonianus.* A, B, Carmel, Monterey County, California. Courtesy of E. H. Taylor. C, Fallbrook, California. U.S. Fish and Wildlife Service photograph. D, Washington. E, Hearst, Mendocino County, California

scales from parietals to base of tail average about 58 or 59 (maximum range 51 to 62); a postnasal and 2 postmentals almost always present.

Recognition Characters. Within its range no other skinks can be confused with this except the other members of the group. The other four-lined skinks of the country do not have the dorsolateral light stripes involving the second scale row, except the striped red-tailed skink (*egregius*) which has a pink tail and 22 or fewer scale rows. From the other members of the group, however, *skiltonianus* is not easy to distinguish.

From *rubricaudatus* it differs in having a blue instead of pink tail in the young, stripes instead of none in the adult, usually 7 supralabials (in the region where *rubricaudatus* occurs) instead of 8, the interparietal short, broad, wedge-shaped, and generally enclosed posteriorly by the parietals (instead of long, narrow, nearly parallel-sided, usually not enclosed by parietals), and a smaller size (frequently over 80 mm. in *rubricaudatus* in an area where *skiltonianus* probably does not exceed 75 mm.).

From *g. gilberti* it differs in its smaller size (maximum 83 mm., as against something over 108 mm. in *g. gilberti*), the occupation of only half or less of the second scale row by the dorsolateral light stripes (as against more than half, when visible), the retention of stripes throughout life (as against loss of them at 55 mm. or over), the occurrence of 7 supralabials in many specimens (generally 8 in *g. gilberti*), and the usual occurrence of 2-2 jubals (about 70 per cent as against about 5 per cent in *g. gilberti*).

For comparisons with *g. placerensis* see the discussion of the latter.

Habitat. In desert regions, as east of the Coast Range, or the Sierras, the species is restricted to mountainous, usually elevated regions where the rainfall is sufficient to support a growth of at least the drouth-resisting oaks or other plants in sufficient quantity to afford protection. Along streams it may penetrate considerable distances into the desert. In Nevada, however, Ruthven and Gaige found specimens in the Cortez Mountains in a canyon where "the slope was covered by a rather profuse growth of grasses and short herbaceous plants, and there were many loose rocks. The skinks were found under the rocks." Over most of its range it is a forest or woods animal. West of the Sierras or of the Coast Range it is more ubiquitous, occurring in treeless meadows and on nearly barren but somewhat grassy hillsides amongst rocks. Whatever the cover, it is always a secretive, terrestrial animal. It occurs to elevations at least as great as 8000 feet above sea level.

Habits. The secretive habits of these lizards are well known. Seldom are they found moving about on the surface of the ground; almost always they are hidden under or within some object. This fact has led some authors to believe they may be nocturnal, or at least procure their food by searching under cover, rather than by seeking free-moving insects. That neither is the case is indicated by a number of recorded observations, particularly by Linsdale, of specimens seen moving about during the day near human habitations, where

the lizards may become inured to the presence of large animals, and also where humans may spend more time quietly in observation than elsewhere. A second similar indication is the discovery of specimens of beet leafhoppers in the stomach of one specimen; their presence indicates a free-foraging habit. Presumably the reason they are so frequently found under objects is that they quietly hide there as the intruder approaches. On the basis of stomach contents (moths, beetles, crickets, and grasshoppers) Tanner suggested more secretive food habits.

Rocks, leaves, logs, and many other types of objects may furnish cover for specimens when disturbed. They are found in the interior of rotten logs at times. They burrow with some ease, utilizing the snout while adpressing the limbs to the sides of the body and tail (Woodbury). Both sexes construct tunnels, sometimes 10 or 15 inches long. Frequent observations are made upon the wriggling or twisting movement executed in the nervous, frantic efforts to conceal themselves when discovered. While foraging the movements are very quiet, but agitated and jerky.

When revealed upon the overturning of a rock or other object under which a specimen is ensconced, the lizard darts away with extraórdinary rapidity; the recovery time from the surprise is extremely brief. Many other lizards hesitate momentarily when uncovered and thus permit more ready capture. When temperatures are low, as in early morning, at high elevations, late in fall, etc., they may be so stiff as to be incapable of running away.

Fitch has observed an interesting fluctuation in density of population over periods of several years, noting that at one locality in Oregon "on a hillside strewn with flat rocks, these lizards were formerly so abundant that at least one could be found beneath every large stone. In 1935 they were rare or absent on this hillside. Similar reductions in number have been noted at different times in other localities."

The normal food includes moths, beetles, crickets, grasshoppers, and leaf hoppers, as recorded in the scanty literature on this topic. In captivity many kinds of insects are eaten, including flies, cockroaches, earthworms, lepidoptera larvae, and fly larvae. The food may be stalked. Woodbury describes how, "standing up with the head drawn back, one waited for a buzzing fly. When it alighted close enough, the skink quickly thrust out its head and caught it." Fitch kept one specimen alive three years in captivity.

The eggs number 2 to 5 in each clutch, according to records from southern California, British Columbia, and Utah. They are laid in excavations under rocks imbedded in the soil. The excavations or nests are flask-shaped, with a fairly large cavity (2 to 3 inches in diameter) at the bottom, communicating by a narrower tunnel (about 1 inch in diameter) as long as 15 inches, which passes along the underside of the rock and reaches the exterior at the rock's edge. Females remain in the nests with the eggs and, for a few days, with the hatchlings, after which time all disperse. The females are variable in reaction

to danger, some running away when the stones are removed, others remaining and attempting to fight off anything entering the nest. Those which flee return to the nest after a time and continue to remain with the eggs, even though the nest may have been tampered with and some eggs removed. If damage has been done to the nest, it is repaired.

The eggs are laid as early as June 15 (Pacific Grove, California), although Tanner suggests July 1 as about the earliest date for Utah. They hatch probably from near the first of July to the end of August; hatchlings are recorded for July 28 and 29 in the San Bernardino Mountains of California and on various dates from August 3 to August 13 in Utah. The rate of growth of the embryo during the later weeks of development has been estimated at 1 mm. a day.

Near Berkeley, California, Rodgers and Memmler record that

> young of *Eumeces skiltonianus* are hatched in the months of July and August. They average about 25 mm. long (snout-vent length) then and grow to about 50 mm. by the time they are one year old. Most of their growth takes place in the first three months of life and in the following April, May and June. These skinks grow to about 65 mm. by the time they are two years old, and to about 68 mm. when they are three years old. Some may breed when they are two years of age, but most of them breed at the end of their third year. The normal life span for individuals once having attained breeding condition is probably five or six years. The oldest individuals are probably not more than nine years old.

Problems. As has been indicated previously, the variation of this form is in need of further study. Almost beyond question several forms are confused at present under the single name *skiltonianus.*

The natural history, because of the animal's secretive habits, is not well known. Periods of activity, food, and the life history are very poorly known and are worthy of investigation.

References. Fitch, 1936, p. 643, habits, habitat (*Ore.*); Grinnell, Dixon and Linsdale, 1930, p. 148, habits, habitat (*Calif.*); Knowlton and Janes, 1933, p. 1015, food (*lit. cit.*); Linsdale, 1938, pp. 29–30, habits (*Nev.*); Lowe, 1943, p. 58, emergence of young (*lit. cit.*); McLain, 1899, p. 10, eggs (*lit. cit.*); Rodgers and Memmler, 1943, pp. 61–68, fig. 1, growth (*lit. cit.*); Ruthven and Gaige, 1915, pp. 26–28, description, habitat, habits (*Nev.*); Tanner, 1944, pp. 81–83, Utah, nesting habits (*Utah*); Taylor, 1936, pp. 415–428, pls. 35, 36, text fig. 68 (*gen. lit.*); Van Denburgh, 1922, pp. 578–584, pl. 60, fig. 1, description, habits (*gen. lit.*); Woodbury, 1931, pp. 59–61, fig. 20, description, habits, habitat, Utah (*Utah*).

Greater Western Skink *Eumeces gilberti gilberti* Van Denburgh

(Figs. 106, 107, p. 343; Pl. 107, A–B)

Range. The Sierra Nevada of central California and the central plateau region of Arizona. Type locality—Yosemite Valley, Mariposa County, California. (Map 28, p. 503.)

Size. Maximum snout-vent measurement 108 mm. (4¼ in.). Tail about 1⅓ to nearly 2 times the head-body measurement. Legs longer than in *skiltonianus*, overlapping or barely failing to do so (adult females) when adpressed.

Color. The young specimens are marked just like the young and most adults of *skiltonianus*. The ground color is dark brown dorsally, and is broken by 2 dorsolateral and 2 lateral light lines. The dorsolateral lines begin on the snout, and on the body occupy two-thirds to five-sixths of the second scale row and a large part of the third row; the lateral light lines occupy the sixth and seventh scale rows. The brown stripe enclosed between these two stripes on each side is very dark. The belly is gray; the tail blue.

As the specimens reach a length of some 50 to 55 mm. (2⅛ in.) snout to vent, the blue color of the tail is lost, and the ground color becomes light in the areas between the light lines, leaving only dark borders next to the light lines. At about 65 mm. (2½ in.) only the anterior part of the dorsolateral light lines are visible, while most of the rest of the body is brownish olive. At a somewhat greater size the entire animal is a uniform brownish olive above, lacking all evidence of stripes. The head, both above and below, and much of the neck become "bright poppy red tinged with carmine." The ventral surfaces, posterior to the reddish throat, are gray to yellowish white.

Scalation. See Figs. 106, 107. Scale rows 24 to 28 around middle of body, generally 26; scales from parietal to posterior margin of thigh 58 to 64, generally 61; supralabials 7 or 8, generally 8; parietals generally separated from each other behind interparietal; latter scale rather broad, short, wedge-shaped.

Recognition Characters. The large size, the loss of pattern at lengths over about 65 mm. (2½ in.) snout to vent, and the inclusion of over half of the second scale row in the dorsolateral light lines when present separate this species from *skiltonianus*. From *rubricaudatus* it is distinguished by its blue tail (as against red) in the young, by the broad, wedge-shaped interparietal (as against an elongate parietal with nearly parallel sides), and by the usual presence of 26 scale rows (as against frequently 24).

In Arizona these skinks are most easily confused with *obsoletus*, the Sonoran skink. The latter generally has the lateral scales in slightly oblique rows, has 2 large superimposed postlabials which are separated from the ear by several flat scales, and a broad, parallel-sided interparietal. In *gilberti* the lateral scales are in perfectly parallel rows, the postlabials are 2 or 3, the lower ones very narrow (vertically) and separated from the ear only by a row of granules, and the parietal is wedge-shaped, narrow posteriorly. There are many other differences, but few that are easily described. In general *obsoletus* tends to have the dorsal scales distinctly black-edged, while Arizona *gilberti* are practically unicolor, with only a feeble darkening on the edges of the scales.

Habits and Habitat. "This lizard is common in the mountains near the Yosemite Valley and is well known to the hotel-keepers and ranch men. It is

often seen in grass and among rocks, retreating swiftly to holes under stones and boulders when frightened" (Van Denburgh).

Problems. Whether this form is actually a distinct species or is a subspecies is not certain. It seems that *g. placerensis* is somewhat intermediate between this and typical *skiltonianus.* Its occurrence in central Arizona, now well assured by several specimens, is most extraordinary; the eastern specimens may actually belong to another race.

The natural history, which should be interesting to compare with that of *skiltonianus,* is not known.

References. Taylor, 1936, pp. 538–446, pls. 37, 38, text figs. 71, 72 (*gen. lit.*); Van Denburgh, 1922, pp. 584–587, pl. 56, fig. 2, description, habits, localities (*gen. lit.*).

Glazed Skink *Eumeces gilberti placerensis* Rodgers

(Pl. 107, Figs. C–D)

Range. "Foothills of Sierra Nevada, below 2500 feet, in southern Yuba, Nevada, Placer, Sacramento, Eldorado, Amador and San Joaquin counties, and on the valley floor east of the San Joaquin River in San Joaquin County." Intergrades with *g. gilberti* in Calaveras, Stanislaus, and Tuolumne counties (Rodgers). (Map 28, p. 503.)

Size. A little larger than the common western skink, maximum snout-vent length 108 mm. (4¼ in.). Gross proportions much as in the common western skink.

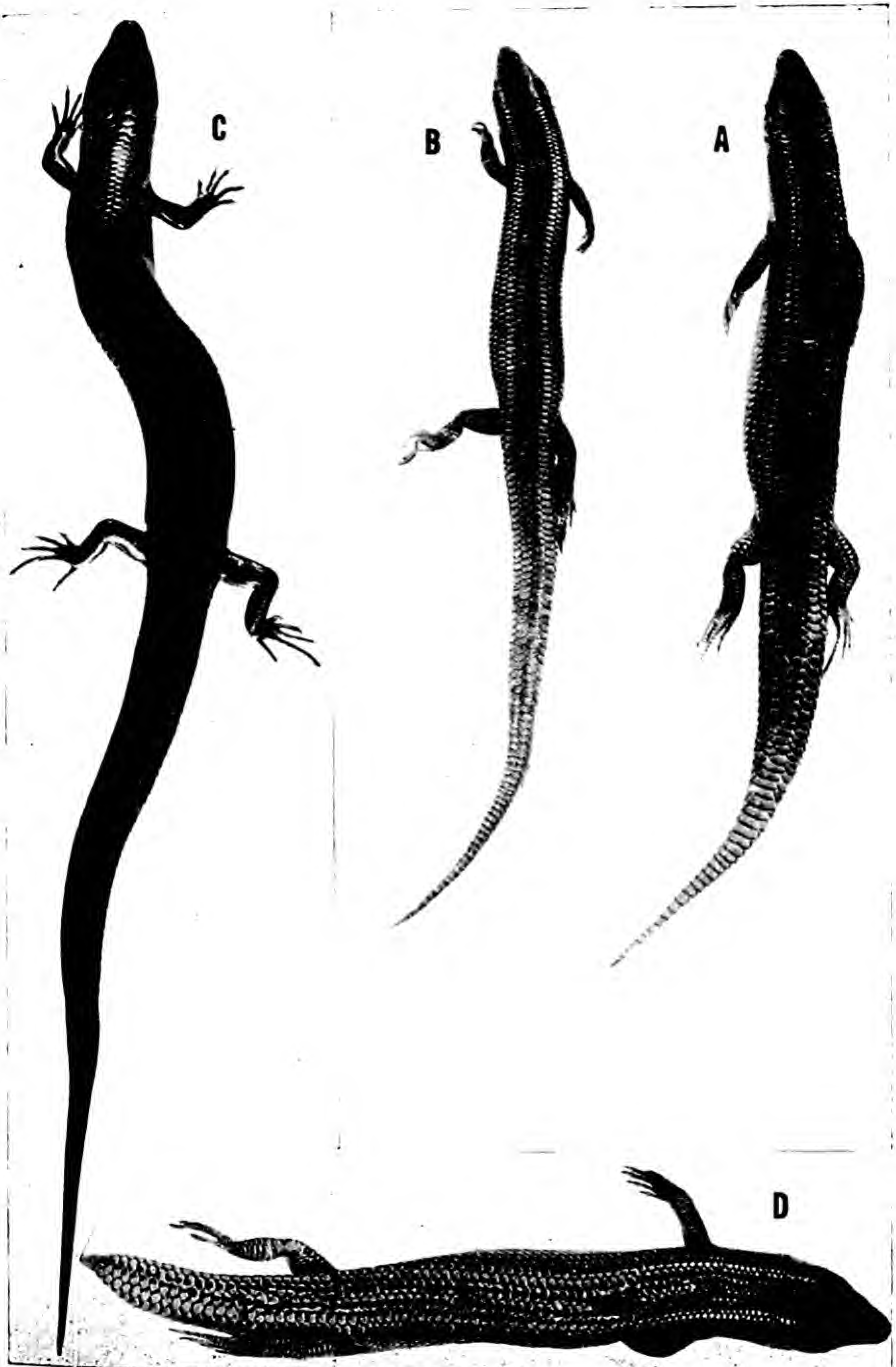
Color. Specimens referred to this race are described by Taylor (under the name *skiltonianus brevipes*) as follows:

In this series the young have the light greenish-white dorsolateral line occupying about three-fifths of the second scale row. The dorsal coloration of the youngest (42 mm.) is gray-olive with black lines bordering the dorsolateral light lines. The lateral greenish-white line begins on the rostral, involves all but the upper and lower edges of the ear, and passes to the tail; below this is a narrow dark line. The tails are lavender above and on the sides; the chin, throat, breast and underside of tail cream; the belly grayish.

Scalation. Much as in the common western skink.

Recognition Characters. Rodgers diagnoses this race as follows:

Bright blue tail color of young retained until the individual has reached a snout-to-vent length of 60–65 mm.; dorsolateral and lateral lines sharply defined in young and in young adults (especially females); some trace of color pattern of back and sides retained in all females (only on sides in largest females), and in all except largest (snout-to-vent length greater than 92 mm.) adult males; scales of dorsolateral light lines possess distinct dark margins. Adults reach maximum size (snout to vent length) of 108 mm.; no sexual dimorphism in size and little or



Pl. 107. A, B, *Eumeces gilberti gilberti;* C, D, *E. g. placerensis.* A, Panamint Mountains, Inyo County, California. B, locality uncertain. C, Auburn, Placer County, California. D, San Joaquin County, California. A, B, D, courtesy of E. H. Taylor; C, U.S. Fish and Wildlife Service photograph.

none in limb length; limbs relatively short. . . . Seven supralabials present slightly more commonly than 8 . . . ; 1 pair of nuchals [= jubals] much more commonly than 2 . . . ; average count of 61 scales (58–64) from occiput (including nuchals) to base of tail (posterior edge of thigh) . . .

The race *placerensis* most nearly resembles *E. g. gilberti,* but in some respects it approaches *E. skiltonianus.* It resembles *gilberti* in its large size, relatively short legs, failure to retain juvenal tail color into adulthood, sexual dimorphism in retention of color pattern, eventual complete loss of color pattern in males, possession of dark edging on scales of dorsolateral light lines, possession of 1 pair of nuchals more commonly than 2, and possession of large average number of scales in a line from occiput to base of tail. It differs from *E. g. gilberti* in longer retention of juvenal tail color (probably into second year in *gilberti* and third year in *placerensis*), longer retention of the color pattern . . . , in having 7 supralabials more often than 8, and in having less sexual dimorphism in adult color pattern and snout-to-vent length. In these ways, it approaches *E. skiltonianus* (*E. skiltonianus* never completely loses the color pattern, and exhibits no sexual dimorphism in adult color pattern or snout-to-vent length). Further, *placerensis* differs from both *gilberti* and *skiltonianus* in having no sexual dimorphism in relative limb length.

Habits and Habitat. Not specifically recorded.

Problems. The relationship of this form to *skiltonianus* is still somewhat in doubt. There is nothing recorded of its natural history.

References. Rodgers, 1944, pp. 101–104, description, illustrations, discussion of validity and status (*Calif.*); Taylor, 1936, pp. 428–431, fig. 68 (*gen. lit.*).

Western Red-tailed Skink *Eumeces rubricaudatus* Taylor

(Figs. 104, 105, p. 342; Pl. 108)

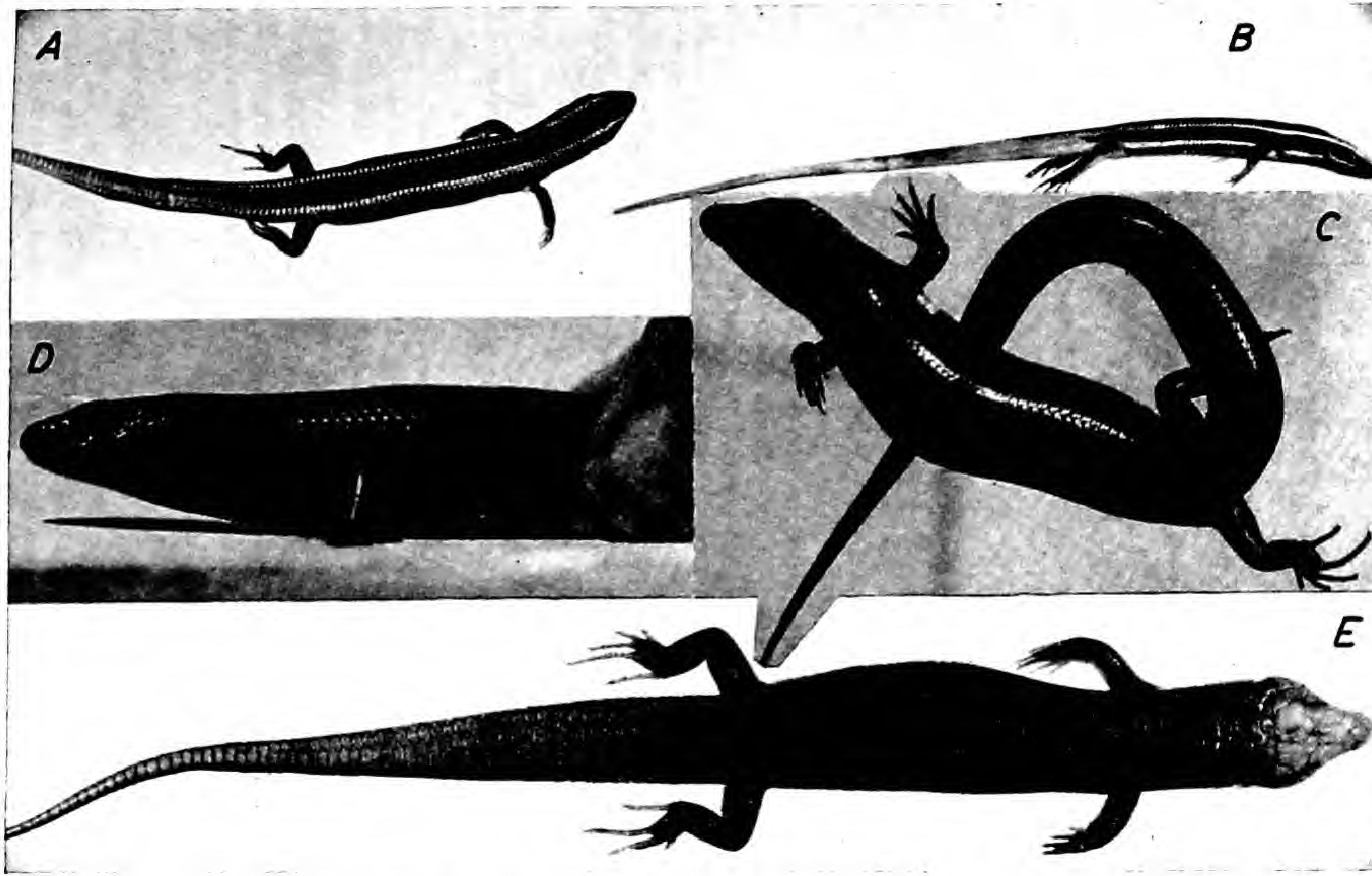
Range. The southern Sierra Nevada of California, and the Coast Range southward to northern Baja California. Type locality—Tehachapi Mountains, California. (Map 28, p. 503.)

Size. A large species, reaching at least 113 mm. (4½ in.) snout to vent, and probably more. The tail is as in other related species, about 1⅔ times to nearly twice the head-body length. The limbs are well developed, overlapping or separated slightly when adpressed.

Color. The young are just as in *gilberti,* except that the tail is pink instead of blue (this distinctive color is lost at about 50 to 60 mm. snout to vent). The dark area present in *skiltonianus* and *gilberti* below the lateral light line is not present in this.

The adults are a uniform olive brown, and the head is of the same color.

Scalation. See Figs. 104, 105. Scale rows around middle of body 24 to 26, but are more frequently (twice as often) 24 than 25 or 26; the supralabials are almost always 8, seldom 7; the dorsal scales from parietal to base of tail 61 to



Pl. 108. *Eumeces rubricaudatus.* A, Tehachapi Mountains, Kern County, California; young. B, Witch Creek, San Diego County, California; young, C, D, south of Bakersfield, California; female. E, Campo, San Diego County, California; male.

64; the parietals and interparietal are very elongate, the latter with its sides almost parallel; the parietals seldom enclose the interparietal posteriorly.

Recognition Characters. The only skink overlapping this species geographically is *skiltonianus,* which Klauber has contrasted successfully with *rubricaudatus.*

In the juvenile state they may be easily distinguished, for *E. s. skiltonianus* has a bright blue tail, while that of *E. g. rubricaudatus* is salmon or pink. Also when fully grown *rubricaudatus* reaches a size beyond that of *skiltonianus,* and loses all its stripes, becoming unicolor olive, whereas *skiltonianus* always retains its stripes. But it is difficult to diagnose *rubricaudatus* by any simple characteristic of color or pattern, between the juvenile state and ultimate adult size; or *skiltonianus,* after it has lost its blue tail. For, when the blue color is gone, the tail is often lavender or pinkish and little different from a half grown *rubricaudatus.*

Taking, as samples, those specimens of which the color, or pattern, make the diagnosis simple, I first checked the . . . differences in scalation given by Taylor (*skiltonianus* with usually 7 supralabials and interparietal usually enclosed by parietals, *rubricaudatus* with usually 8 supralabials, and interparietal usually not enclosed). I found among San Diego county specimens the first difference to be maintained with considerable consistence, but the second was not. However, there is another difference in the interparietal which is quite consistent and will solve most questionable cases, particularly if a few specimens already diagnosed by color are available for comparison; in *skiltonianus* the interparietal is sharply wedge-shaped, while it is more blunt in *rubricaudatus,* the sides tending toward parallelism.

A comparison with *g. gilberti* is given in the discussion of the latter.

Habits and Habitat. Not recorded. Presumably much as in the other western skinks.

Problems. Taylor described this as a subspecies of *gilberti,* admitting some doubt regarding the correct status of the form whether species or subspecies. My own interpretation of published data would favor more strongly the assumption of intergradation between *gilberti* and *skiltonianus* (through *placerensis*) than intergradation between the first and *rubricaudatus.* Geographically intergradation between all is possible. However, here the specific distinctness of *gilberti* is accepted upon the strength of Taylor's decision, supported by Rodgers; and I believe the case for making a subspecies of *rubricaudatus* is not adequate, granting that the correctness of neither alternative can be proved at the moment. In the red-tailed species the head is more elongate and the parietals and interparietal are shaped differently from the scales in other species of western skinks. Moreover, I know of no well-authenticated case in which a red-tailed form intergrades with a blue-tailed one, although the condition found in the western skinks, of closely related blue- and red-tailed species living together, is paralleled in other genera (e.g., *Leiolopisma* in Central America). The situation needs careful study.

Life history studies, involving the hatching of egg clutches, will aid in the taxonomic problem the species presents. Nothing is known at present.

References. Klauber, 1939, pp. 99–100, as quoted (*Ariz.*); Taylor, 1936, pp. 446–451, pl. 39, text figs. 32, 33 (*gen. lit.*).

The Eastern Red-tailed Skinks—Egregius Group

The group is entirely confined to the United States, in Florida and adjacent areas to the north. It is one of the most unusual of the genus, lacking a primary temporal (Fig. 103) and having the ear opening partly closed, a very small number of scale rows around the middle of the body (18 to 22), very small limbs which are widely separated when adpressed, only 3 (Fig. 102) instead of the usual 4 supraoculars, a very small size, a pink tail throughout life, no median light stripe either on body or head, and the dorsolateral light stripes involving the second scale row. A pink or reddish tail occurs in a few other species of the genus but is characteristic only of the very young, the tail becoming the same color as the body in older specimens.

Striped Red-tailed Skink *Eumeces egregius* (Baird)

(Figs. 102, 103, p. 342; Pl. 109)

Range. Discontinuous; extreme southeastern Georgia, southern Alabama, and adjacent Florida, and the keys of extreme southern Florida. Type locality —Indian Key, Forida. (Map 29, p. 504.)

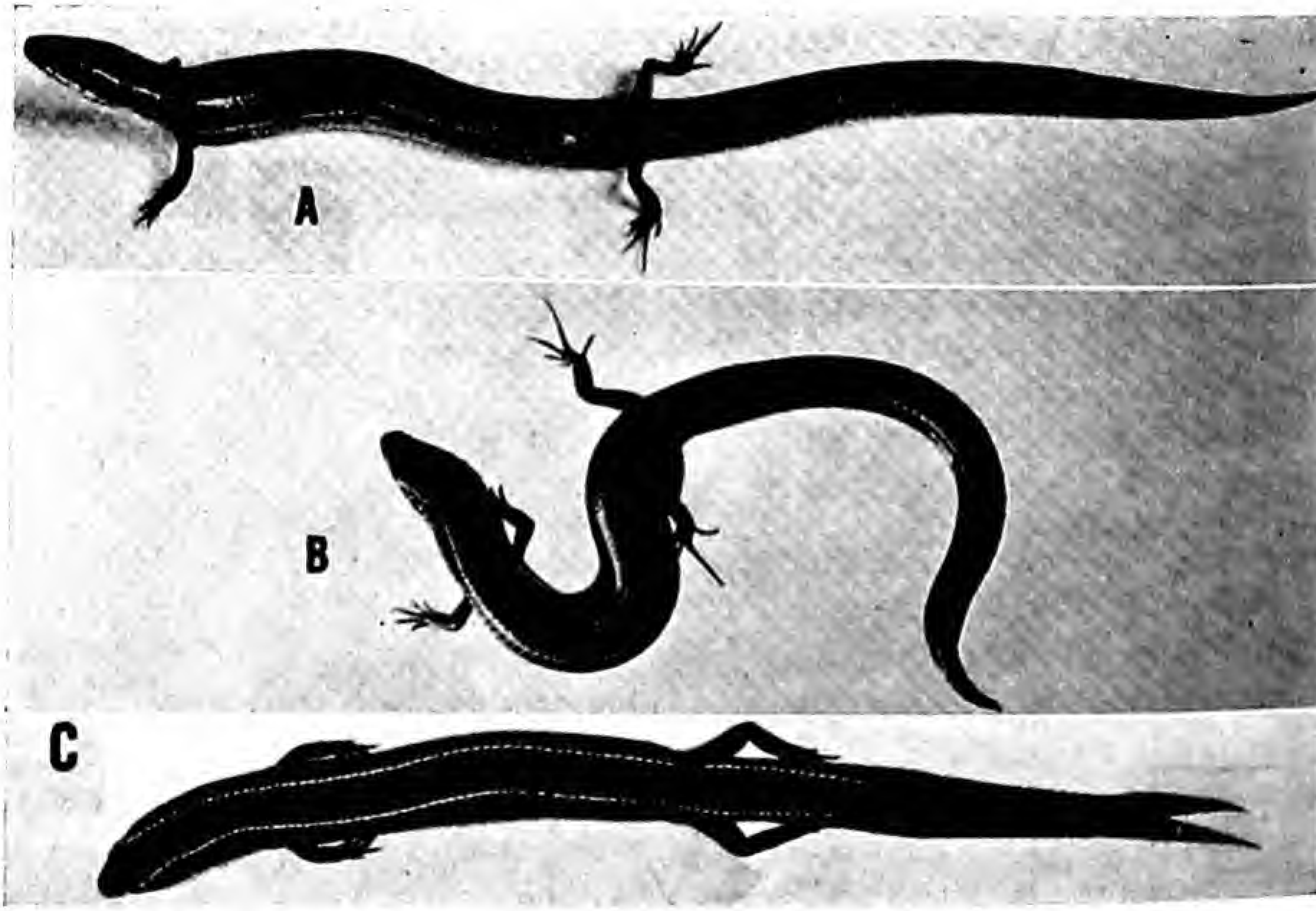
Size. A small species, the maximum snout-vent length 57 mm. (2¼₁₆ mm.). The tail is about 1⅔ times the head-body length. The body and tail are slender and elongate and the limbs short and weak; when adpressed to sides of the body the limbs fail to overlap by about 10 or 12 scale lengths.

Color. Dorsal surface gray-brown to dark chocolate brown, most of the median area lighter; a narrow light stripe along the middle of the second scale row, extending from the superciliary region (and rostral) onto the basal third of the tail, there disappearing; this line bordered medially by a narrow, chocolate brown line. Sides of body gray-brown, this color bordered below by a narrow, lateral, light stripe, not so distinct as the dorsolateral stripes, extending from the rostral and supralabial region along the middle of the fifth or sixth scale rows, disappearing at the base of the tail. Below the lateral light line is a narrow dark area merging with the light ventral color. The entire ventral surfaces of the head and body are white or cream. The tail, both above and below, is orange-red, in both young and adults. The tip of the snout also is pinkish.

Scalation. See Figs. 102, 103. This species and its close relative, the brown red-tailed skink, has a number of most peculiar characters in scutellation.

There is no postnasal; there are 6 or 7 supralabials; only 3 supraoculars; only 2 temporals (the upper secondary and tertiary), the primary and lower secondary are missing; there is a rather large scale that partly conceals the ear opening, overlapping it from the upper anterior border; there are 2 postmentals. There are 20 or 22 scale rows about the middle of the body and 64 to 69 dorsals from occiput to base of tail. The scales in the two median rows on the body are distinctly wider than adjacent scales. The median row of subcaudal scales also is rather broad.

Recognition Characters. Any skink from the eastern United States with a pink or pinkish tail is certainly the striped or brown red-tailed skink; and



Pl. 109. *Eumeces egregius.* A, Key West, Florida. U.S. Fish and Wildlife Service photograph. B, same locality. C, Big Pine Bay, Florida. Courtesy of E. H. Taylor.

these two species can easily be distinguished from the western red-tailed species by the presence of only 3 supraoculars, by the fewer scale rows (20 or 22, instead of 24 or more), by the position of the dorsolateral light stripes (not involving the third scale row in *egregius*), or by other distinctive features. From the brown red-tailed skink the striped species can be distinguished by having the light stripes running the full length of the body (instead of disappearing on the anterior part or near the middle), and by having the scales in the two median dorsal rows notably wider than adjacent scales.

Habitat. "High pine; live-oak hammock; piles of rocks, debris, and wave-washed wrack on the Florida Keys" (Carr).

Habits. "Partly fossorial, but often seen running about. On the Upper Keys I found them numerous among the rocks but a few feet above the water on the railroad embankments" (Carr). Neill records specimens from "open areas of sandy soil unsuited to any other of the Georgia lizards except *Cnemidophorus sexlineatus.*" One specimen recorded contained 6 eggs.

Problems. Practically nothing is published on the natural history of these interesting skinks. Taxonomically, the problem now is not whether the brown and striped red-tailed skinks are different species, but whether the northern striped specimens are the same as the southern ones; they are widely separated geographically, and a few specimens examined showed differences both in pattern (position of lateral light line) and scutellation of the head.

References. Carr, 1940, p. 75 (*Fla.*); Neill, 1940, p. 266 (*Ga.*); Taylor, 1936, pp. 490–496, pl. 31, fig. 2, text figs. 83–84 (*gen. lit.*).

Brown Red-tailed Skink *Eumeces onocrepis* (Cope)

(Pl. 110)

Range. Central and southern Florida from Lake to Dade counties. Type locality—Dummet's Plantation, 20 miles south of Smyrna, Florida (now Allenhurst). (Map 31, p. 505.)

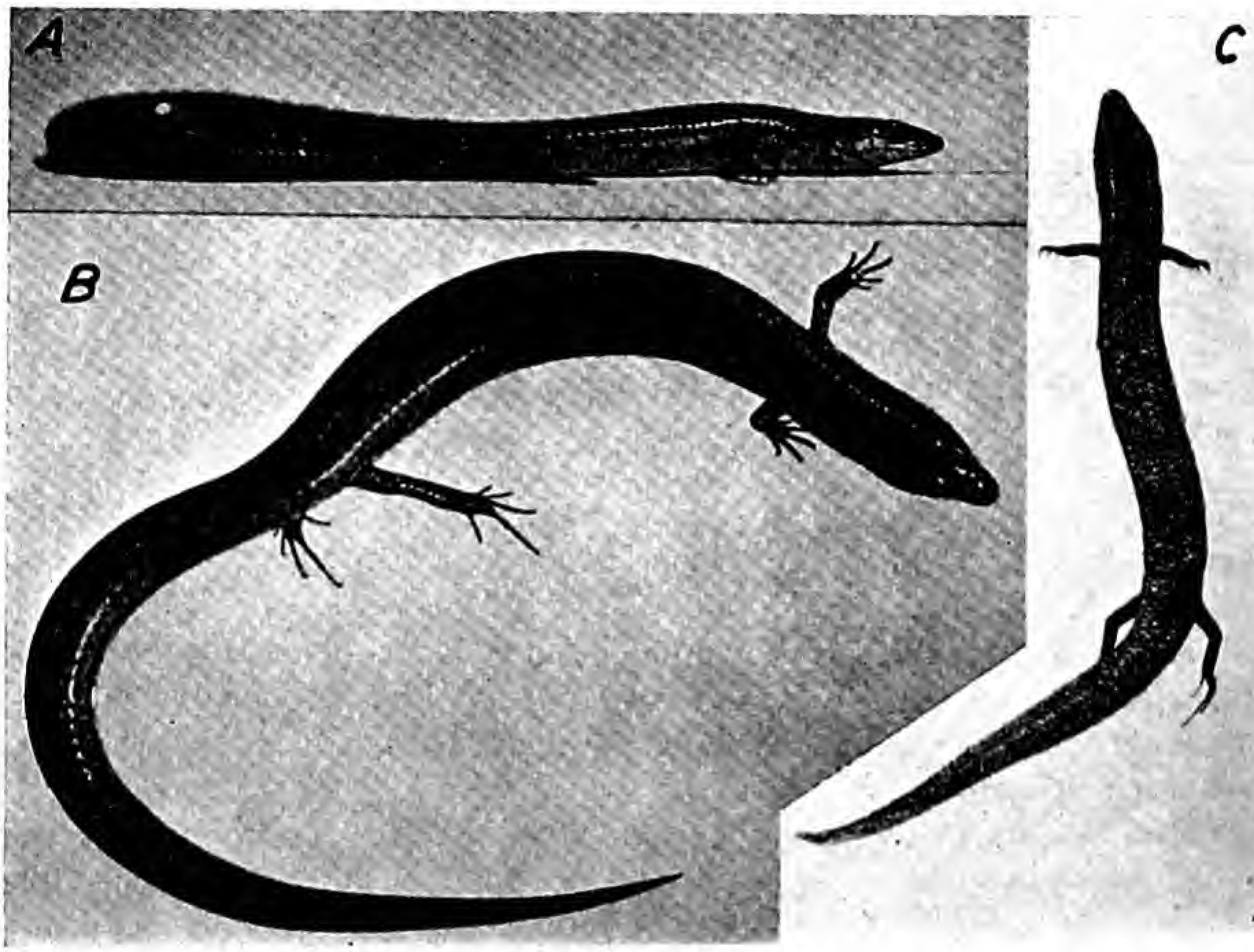
Size. A small species, the maximum snout-vent length recorded 58 mm. ($2\frac{5}{16}$ in.). The tail is $1\frac{1}{2}$ to 2 times the head-body length. The body and tail are slender and elongate, and the limbs short and weak. The adpressed limbs are widely separated.

Color. Yellowish brown above and on sides, becoming lighter posteriorly; a dark-edged light line extending from rostral onto shoulders; at about this point its dark medial border disappears, and although the stripe is a little lighter than the ground color, it becomes less and less distinct posteriorly, finally disappearing completely on the posterior third of the body. At the most posterior point at which its full width is visible it occupies the adjacent halves of the second and third scale rows. It is bordered below by a dark band occupying 1 full and 2 half scale rows, its upper edge following the middle of the third row; this band also may be indistinct or absent on the posterior part of the body, but in some specimens it remains visible. A light line extends along the lip to the ear and then continues posteriorly to near the middle of the body, becoming less distinct posteriorly. There are no median lines on head or body. The chin is white or cream. The belly is mostly white, but somewhat stippled; the pigment of the sides of the body is separated at the middle of the belly by the width of about 4 full and 2 half scale rows. The tail is pink.

Scalation. Like that of the striped red-tailed skink except that the scales of the two median rows on the body are not at all, or but very slightly, wider

than the adjacent scales. The rows about the middle of the body vary from 18 to 22 but are usually 20. There are 60 to 67 dorsal scales from the interparietal to the base of the tail.

Recognition Characters. No other kind of skink, except the striped red-tailed species, has a combination of a red tail (in either young or old) and only 18 to 22 scale rows, and these two are the only skinks of the eastern



Pl. 110. *Eumeces onocrepis.* A, B, 100 miles north of St. Petersburg, Florida. C, Auburndale, Pope County, Florida. Courtesy of E. H. Taylor.

United States with a red tail. The pattern will distinguish the brown from the striped species, the latter having light stripes that extend the full length of the body whereas in the former they disappear at the middle of the body or anterior to that point. Furthermore, the striped species has 2 rows of noticeably broadened scales on the middle of the body; in the brown species these rows are the same size as the others on the body.

Habitat. "Rosemary scrub, high pine, and live-oak hammock; in dry sandy soil or under logs" (Carr).

Habits. "Chiefly fossorial; sometimes ploughed up in sand a foot or more deep. Less active than *egregius*" (Carr).

Problems. The natural history of this diminutive skink is practically unknown.

References. Carr, 1940, p. 75 (*Fla.*); Taylor, 1936, pp. 497–502, pl. 31, fig. 1, text fig. 84 (*gen. lit.*).

The American Burrowing Skinks

Genus *NEOSEPS* Stejneger

But a single species is known of this peculiar genus, restricted to Florida. The greatly reduced limbs, the absence of an ear opening, and the shovel-shaped snout are characteristic.

Florida Sand Skink *Neoseps reynoldsi* Stejneger
(Fig. 93, p. 334; Fig. 120, p. 395; Pl. 111)

Range. Central and southern Florida. Known only trom Alachua, Dade, Highlands, Lake, and Polk counties. Type locality—near Spring Lake, Fruitland Park, Lake County, Florida. (Map 30, p. 505.)

Size. Maximum snout-vent length about 60 mm. (2⅜ in.) so far as recorded at present; tail exactly as long as body in single specimen examined with a complete tail.

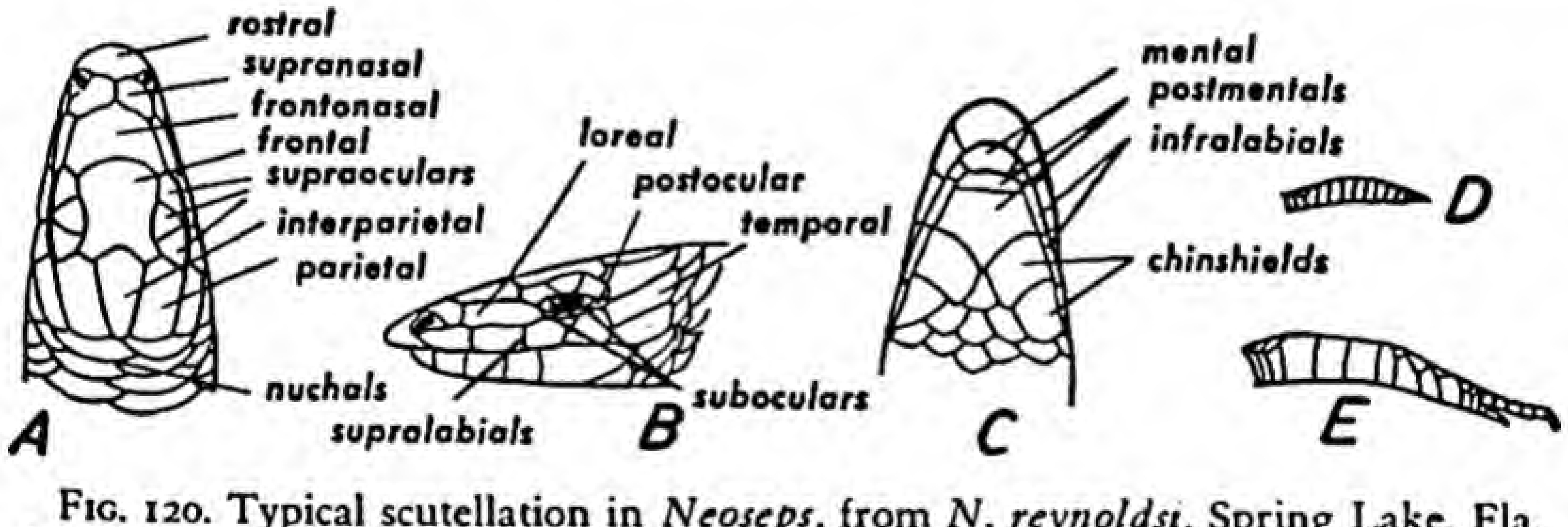
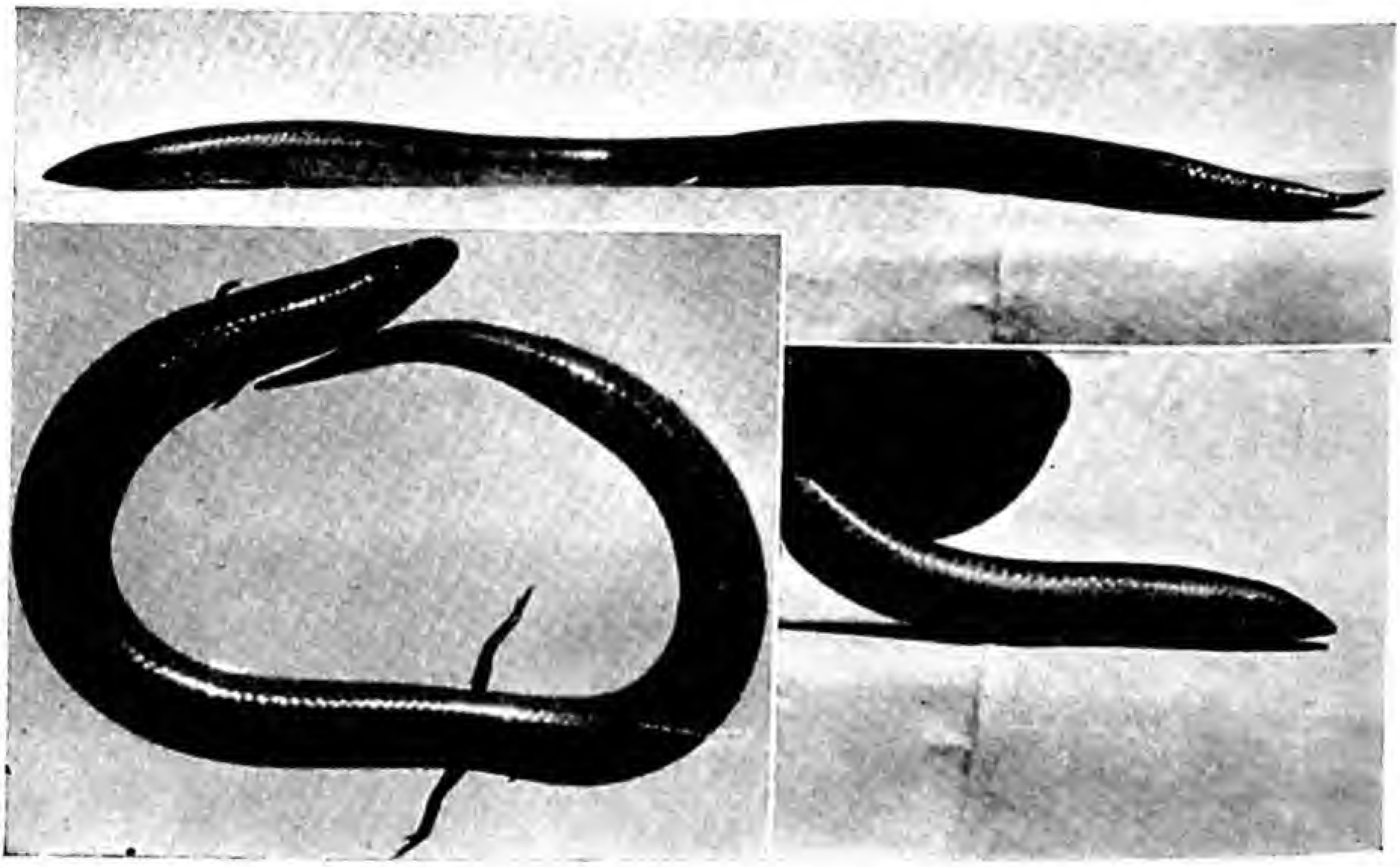


FIG. 120. Typical scutellation in *Neoseps*, from *N. reynoldsi*, Spring Lake, Fla. A, top of head; B, side of head; C, underside of head; D, foreleg; E, hind leg. From Stejneger.

Color. Light yellow-gray to light brown above; a series of double dark spots, a pair on every scale, on each of the two median scale rows, extending from head to base of tail; a series of similar spots, double or single, on the other scale rows, but faintly developed ventrally. A feebly defined light stripe involving the adjacent halves of the second and third scale rows; sides of body below this slightly darker. A distinct dark streak on each side of head, ex-

tending from snout through eye onto neck, there breaking up into the dotted lateral area of the sides of the body. Tail with numerous flecks above, arranged more or less in longitudinal series.

Scalation. See Fig. 120. Head flat below, smoothly rounded above, with a rounded, sharp-edged snout flush with the lower jaw. Eye reduced, but protected by a lid with a big, translucent, scale "window" in its center; ear opening completely covered by overlapping scales; all body scales smooth, overlapping, in 16 rows, those of the two middorsal rows a little widened, those of the two midventral rows narrowest (about as broad as long); a sharply defined keel on either side of belly, producing a flat or concave ventral surface;



Pl. 111. *Neoseps reynoldsi.* Eustis, Florida.

forelegs ridiculously short, about as long as distance between eye and nostril, fitted posteriorly in a groove above the lateral keel, and consisting of a single digitlike structure terminating in a short claw. Hind legs longer but quite useless, terminating in 2 clawed digits, one about twice as long as the other. Median subcaudal scales widened, others subequal; median subcaudal scales on regenerated part of tail no wider than other scales.

Recognition Characters. The ludicrously short limbs—the front ones so small as to be easily overlooked at first glance—the absence of an exposed ear opening, the reduced number of scales around the body; and the window in the lower eyelid all characterize this extraordinary species. The first character alone is sufficient to separate it from all other lizard species of the United States.

Habitat. "Rosemary scrub and high pine; under logs and in loose dry soil" (Carr).

Habits. "Completely fossorial; in dry sand it burrows rapidly with a swimming movement. O. C. Van Hyning received several from a crew engaged in sifting sand at the Eustis (Lake County) airport; he informs me that some of these were found at a depth of two feet" (Carr).

Problems. Published information on the natural history of these extraordinary lizards is extremely scanty. So far as I know the above comments are the only ones about them. Furthermore, the relationships of the genus are very puzzling; a complete anatomical study of it, and of similar genera in other parts of the world, may show whether the several scattered genera of burrowing, degenerate-limbed skinks are actually closely related to each other or have been independently derived from various other genera with well-developed limbs.

References. Burt, 1939, pp. 363–364, brief description, localities (*Ala.*); Carr, 1940, p. 77, habits and habitat as quoted, range (*Fla.*); Stejneger, 1910, pp. 33–35, figs. 2–6, description (*Fla.*).

The Lacertids

Family LACERTIDAE

This is an exclusively Eastern Hemisphere family. It is included here only through the importation into this country and the accidental establishment, at least for a time, of a single species. There are some twenty-five genera and two hundred and fifty forms in the family. It has been supposed that the lacertids have been derived from our common family Teiidae, or from their near ancestors. Certainly some members of each of the two families show great resemblances to each other, as *Lacerta* does to *Cnemidophorus*. The Lacertidae differs from the Teiidae in having dermal plates on the head (often fused with the skull), and in having pleurodont teeth open basally (not open, often acrodont, in the Teiidae).

The European Racerunners

Genus *LACERTA* Linnaeus

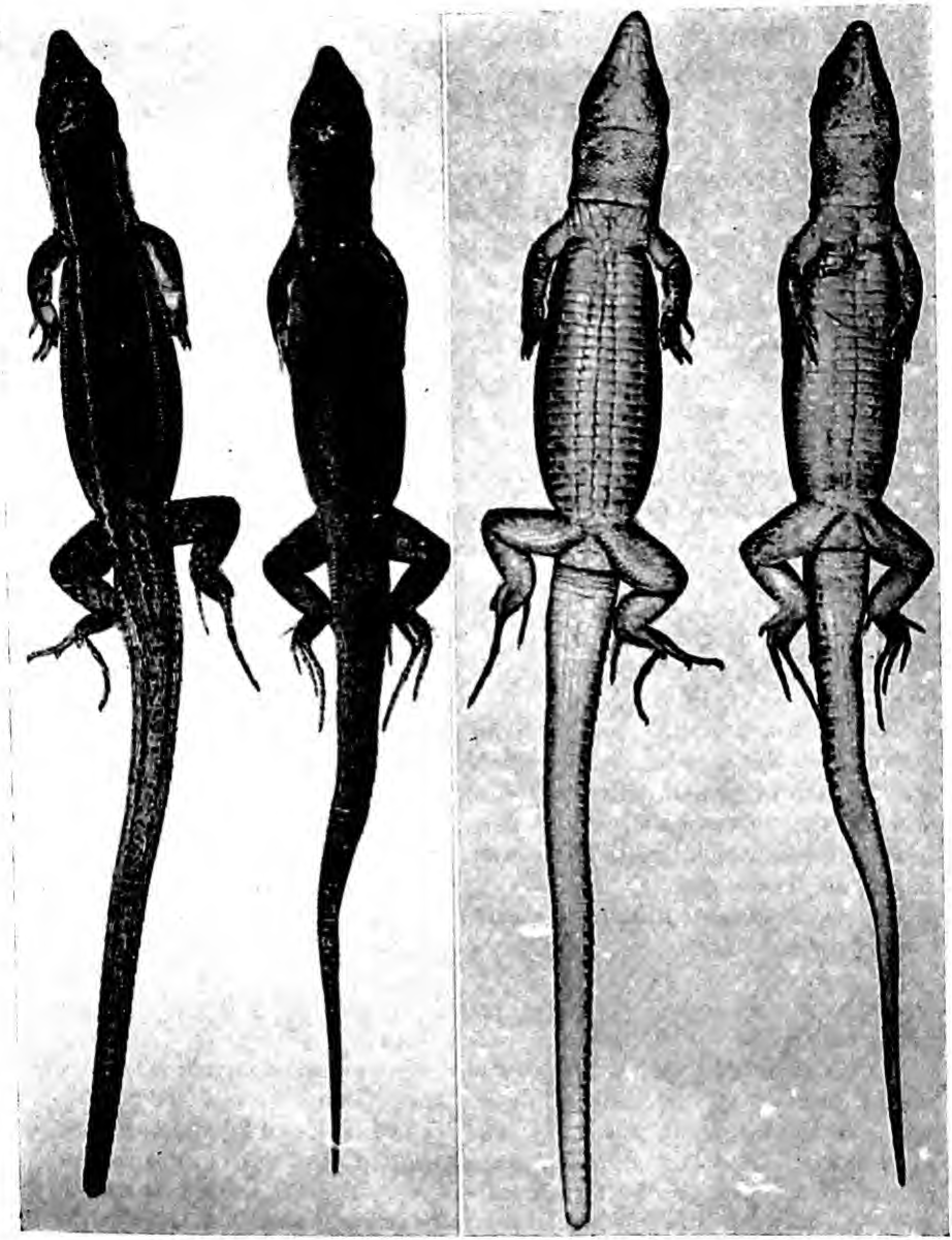
This is a widespread, exceedingly variable genus whose taxonomy has been the subject of as much differing opinion as has that of the corresponding American genus of the Teiidae (*Cnemidophorus*).

Fiume Wall Lizard *Lacerta melissellensis fiumana* Werner
(Pl. 112)

Range. Eastern border of the Adriatic Sea, southward to northern Greece and adjacent islands. Type locality—Fiume.

Size. Maximum snout-vent measurement about 68 mm. ($2\frac{5}{8}$ in.); tail $1\frac{3}{5}$ to $2\frac{1}{5}$ times as long as head and body. Body rather elongate, cylindrical; legs relatively short, powerful.

Color. Blue-gray above, frequently perfectly uniform and without darker markings, but at other times with a striped pattern of brown and light stripes, either scarcely evident or well defined. The pattern, when well developed, consists of a broad, dark brown, light-edged, median stripe extending from head to base of tail, frequently enclosing within itself small, irregular, reddish-



Pl. 112. *Lacerta melissellensis fiumana*. Zengg, Croatia. Maas photographs.

brown spots; a dorsolateral light line extending from eye through ear opening to groin, also bordered on either side by scattered dark spots; an irregular series of dark spots along the outer row of ventral plates; the ground color of the sides of the body brownish; scattered dark spots on sides of throat; ventral surfaces somewhat bluish.

Scalation. Dorsal body scales very small, uniform, feebly keeled; head scales large, regular; ear openings and eyelids distinct; belly plates large, flat, rectangular, in 6 longitudinal rows; a well-defined, granular, gular fold, bordered anteriorly by a row of enlarged scales. A large, median, preanal scale; no enlarged postanals; femoral pores 16 to 23 on each side, the two series separated by 1 scale medially.

Recognition Characters. The large, flat, belly scales in 6 longitudinal rows (not 8) and the minute dorsal scales will separate this species from any other lizard known in the United States.

Habitat. A terrestrial lizard.

Habits. The story of this species in the United States is quoted from Kauffeld's article, in which the presence of the lizard in this country was first recorded.

During the summer of 1927, Mr. Arthur Foehl, Jr., of West Philadelphia, a dealer in animals who is well known for the interesting collections of reptiles and amphibians which he usually has for sale to scientific institutions, had the misfortune to lose a number of European lizards, of the genus *Lacerta,* by their escape from the cage in which they were confined. They made their way to a small stretch of ground, at the rear of Mr. Foehl's residence, which slopes downward to the tracks of the Pennsylvania Railroad. In this open space where the heavy growth of high grass afforded ample insect food and protection, the escaped lizards made their home.

Mr. Foehl was able to retrieve a part of his specimens by making a collecting tour of the field. Some small boys of the neighborhood were also known to have found a few. Great was his surprise, however, when the following year he obtained some very young specimens upon the same ground. It was my privilege to observe the latter while they were in Mr. Foehl's possession.

In the autumn of 1929, further proof of the fact that these lizards were breeding in this new locality was furnished by Mr. Harry Rosenthal, also of Philadelphia, who collected three half grown individuals which he found hiding under rail ties piled nearby. The following record is no later than April third of this year, when the writer, accompanied by Mr. Rosenthal, was fortunate enough to secure two more specimens; one half-grown and the other fully grown. The larger specimen was found running along the ground, probably having been disturbed while basking in the sun of early spring. The small one was found under a flat stone. Inquiries at a lumber-yard situated at one end of the field, revealed that the lizards are very numerous in the piles of lumber during the summer months.

Were it not for the confining city streets which surround this plot of ground, it is probable that these hardy lizards would so firmly establish themselves as to

become a permanent part of the reptilian fauna of Pennsylvania. The similarity in climate between this locality and their ancestral Europe, plus an abundance of food, offers a habitat in which they thrive. It is possible, though hardly probable, that the railway may serve as an aid to dispersal to a region less densely populated by human beings. Thus the species might become more widely distributed.

Having no knowledge of the exact source of the original specimens, it is impossible to be definite with regard to the identity of the recently obtained, American-bred, specimens. However, they seem to agree with Boulenger's *Lacerta muralis* var. *fiumana*, described in the first volume of his "Monograph of the Lacertidae." Mertens and Müller, in their check list of European amphibians and reptiles, place this variety under *Lacerta melisellensis fiumana* Werner, the forma typica of which Boulenger considered a variety of *Lacerta muralis*.

Reference. Kauffeld, 1931, pp. 163–164, as quoted (*lit. cit.*).

The Teiids

Family TEIIDAE

The members of this family are almost as diverse in appearance as those of the family Anguidae. Some are diminutive and very skinklike, others elongate, degenerate, and practically limbless; a few are large and powerfully built, and others are of normal size and proportions.

The family is restricted to the Western Hemisphere, where it is represented by about forty genera, only one of which reaches the United States. Practically all genera are restricted to South America.

The teeth run a gamut of variation perhaps equaled in no other single lizard family. The front teeth are always conical, but the lateral teeth of both jaws may be "conical, bicuspid, tricuspid, obtuse or molar-like (adult *Tupinambis*), or enormous oval crushers (*Dracaena*)"; the bicuspid teeth may be compressed laterally or anteroposteriorly as in *Dicrodon* and *Teius* (Boulenger, *gen. lit.*, vol. 2, p. 330).

The American Racerunners

Genus *CNEMIDOPHORUS* Wagler

Few genera of the country have been studied and restudied with greater resulting disagreement than this. The species enter many habitats and are represented by a population which is usually extremely abundant, and the range of variation exhibited by all is very great. The pattern generally goes through a gradual transformation beginning shortly after birth and continues indefinitely, so that specimens living longer than others, even though of exactly the same subspecies, may have a final pattern quite unlike that of their shorter-lived brethren. To add to these facts is the unfortunate truth that these lizards quickly discolor when placed in formalin (a very commonly used preservative) or if not promptly preserved. Because of their abundance enormous numbers of specimens have been collected, although too frequently they have been gathered with no, or little, attention to the proper representation of all sizes or to proper care in preservation. The difficulties attending

the study of the whole genus have now multipled so greatly that further contributions to its systematics must deal with it piecemeal. This is exactly how a few of the many problems are now being attacked, with a success greater than has attended the efforts of anyone who has attempted to deal with the entire genus all at once.

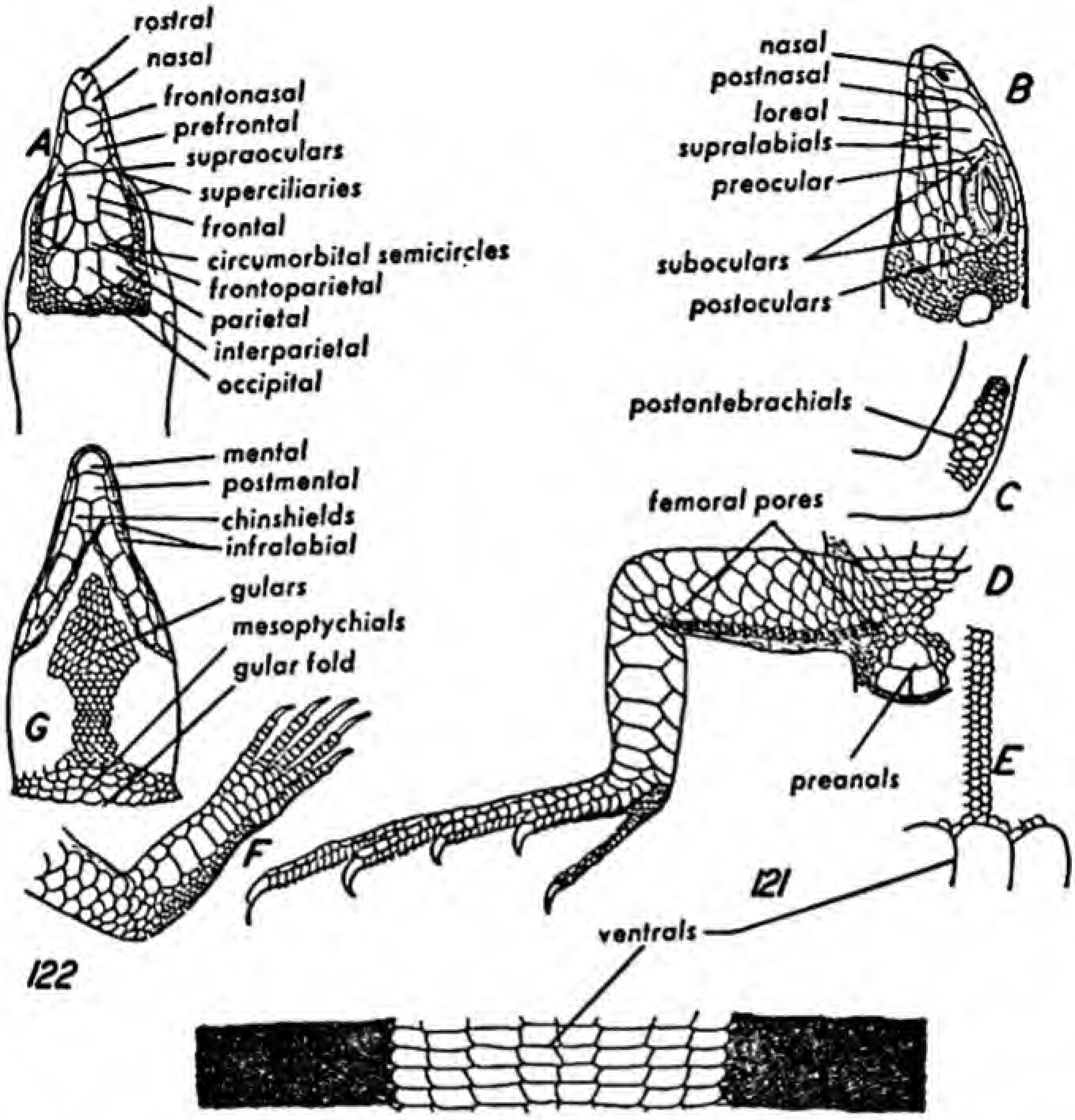


FIG. 121. Typical scutellation in *Cnemidophorus*, from *C. g. gularis*, near Long. 32° N. A, top of head; B, side of head; C, underside of left foreleg; D, ventral view of right hind leg and anal region; E, section of scales from side of body; F, upper surface of right foreleg; G, underside of head. From Cope.

FIG. 122. Strip of scales around center of body, broken at mid-dorsal line, from *Cnemidophorus sexlineatus*, Ooltewah, Hamilton County, Tenn. From Burt.

Because of the vagueness regarding the status of the species and subspecies of *Cnemidophorus*, no reliable estimate of the number that exist can be given. By lowest estimate about twenty-five are included in the genus; but other estimates are as high as about forty-five. These are distributed from northern United States southward through southern Brazil and Bolivia.

All species have granular dorsal scales, very large, quadrangular, belly scales in 8 to 12 longitudinal series, a long series of femoral pores, and the tail

scales different from any of those on body. Some details of the scutellation of a typical form are shown in Figs. 121 and 122.

All species are diurnal, egg-laying, and insectivorous.

KEY TO SPECIES OF *CNEMIDOPHORUS*

1. Only 1 frontoparietal plate (Fig. 123) .... *hyperythrus beldingi* (p. 428)
   Two frontoparietals (Fig. 124) 2

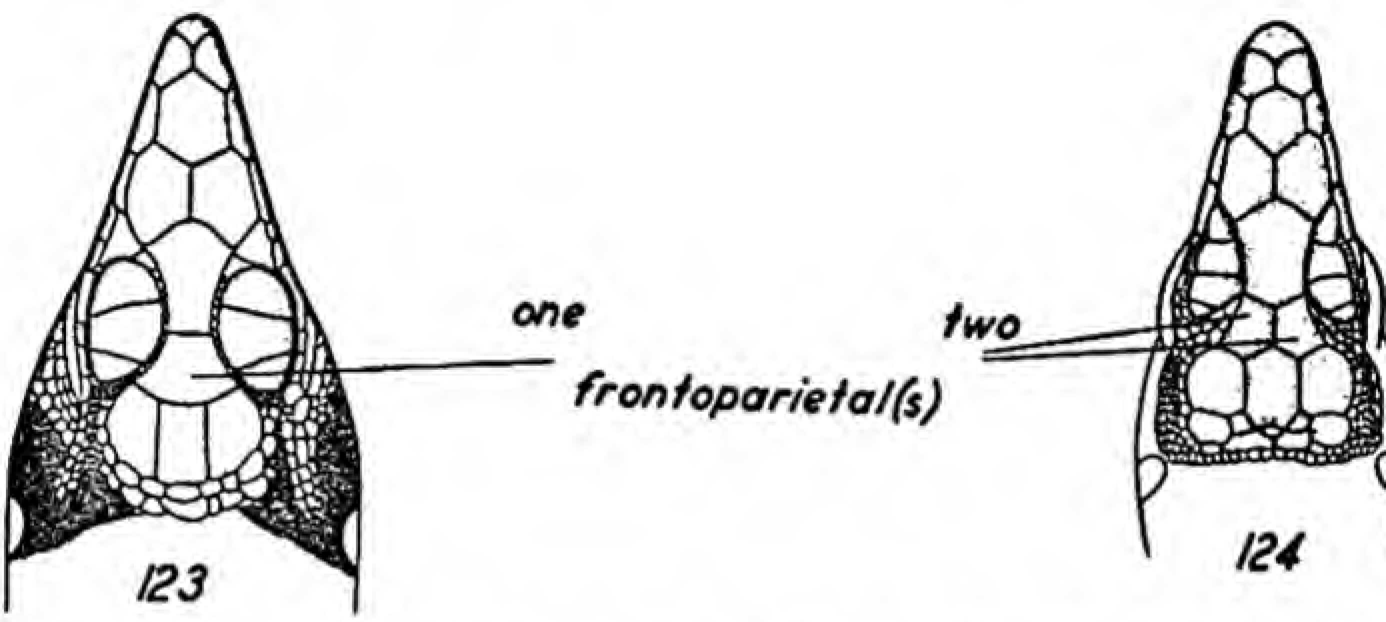


FIG. 123. *Cnemidophorus hyperythrus schmidti,* top of head. From Burt, after Cope.

FIG. 124. *Cnemidophorus tesselatus,* top of head. From Burt, after Cope.

2. Light lines continuous, straight, both on sides and on back; no crossbars on sides or back 3
   Light lines broken, or wavy, on sides or back; crossbars sometimes present 7
3. Enlarged scales preceding gular fold relatively small, frequently grading into the granular scales of the fold posteriorly (Fig. 125) 4
   Enlarged scales preceding gular fold relatively large, abruptly differentiated from granular scales of fold (Fig. 126) 5
4. Ventral surfaces light, bluish in adults; juvenile striped pattern retained throughout life; maximum snout-vent length 70 mm. (2¾

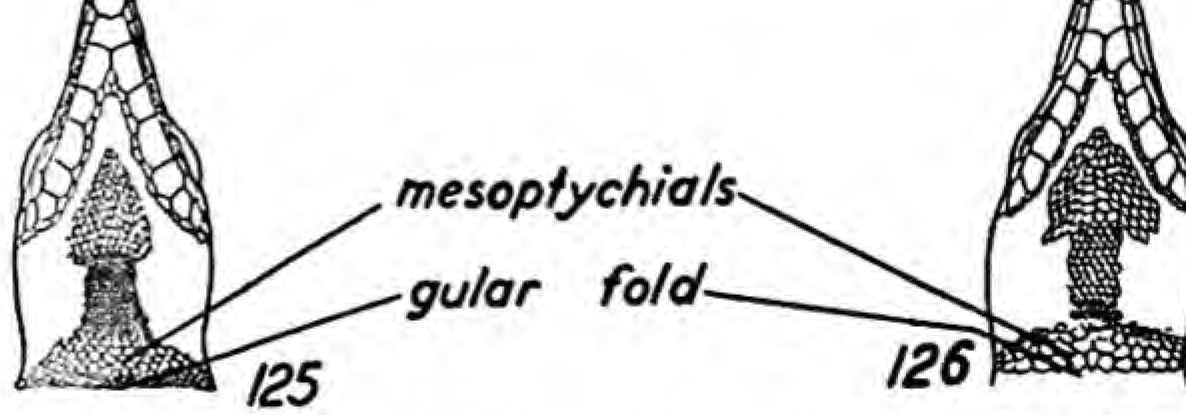


FIG. 125. *Cnemidophorus t. tesselatus,* underside of head. From Cope.

FIG. 126. *Cnemidophorus gularis octolineatus,* underside of head. From Cope.

in.); dorsal scales relatively large, 50 to 70 in a transverse row between the enlarged belly plates .... *perplexus* (p. 412)

Belly, chest, or gular region dark (black) in adults; juvenile striped pattern broken by spots or bars in adults; snout-vent length reaching 95 mm. ($3\frac{3}{4}$ in.); dorsal scales 85 or more in a transverse row .... *tesselatus aethiops* [1] (p. 424)

5. In addition to a dorsolateral light stripe on tail, a lateral light stripe is present which is bordered below by a black line (near base of tail) and continues on the otherwise unicolor posterior surface of the thigh; no light spots in dark fields between stripes in adults; postantebrachials equal, none notably enlarged; neither sex dark blue nor orange below .... *sexlineatus* (p. 415)

No lateral light stripe on tail, at least not distinguishable from the ventral tail color; thighs mottled, no posterior light stripe except sometimes feebly indicated at insertion of leg; light spots in dark fields between stripes, present at least in adults; postantebrachials distinctly enlarged generally, sometimes less so in females; males frequently dark blue on belly, throat orange 6

6. Maximum size, snout to vent, about 86 mm. ($3\frac{3}{8}$ in.); males with orange throats and dark blue chests; dorsal pattern not broken into dark crossbars in adults .... *gularis gularis* (p. 406)

Maximum size, snout to vent, reaching 125 mm. (5 in.); males as well as females a more or less uniform whitish below; pattern frequently broken into crossbars in adults .... *gularis octolineatus* (p. 409)

7. One or more rows of conspicuously enlarged scales on posterior surface of lower foreleg (Fig. 127); belly never gray or black suffused .... *gularis octolineatus* (p. 409)

Scales on posterior surface of lower foreleg nearly uniform in size, none conspicuously enlarged (Fig. 128) 8

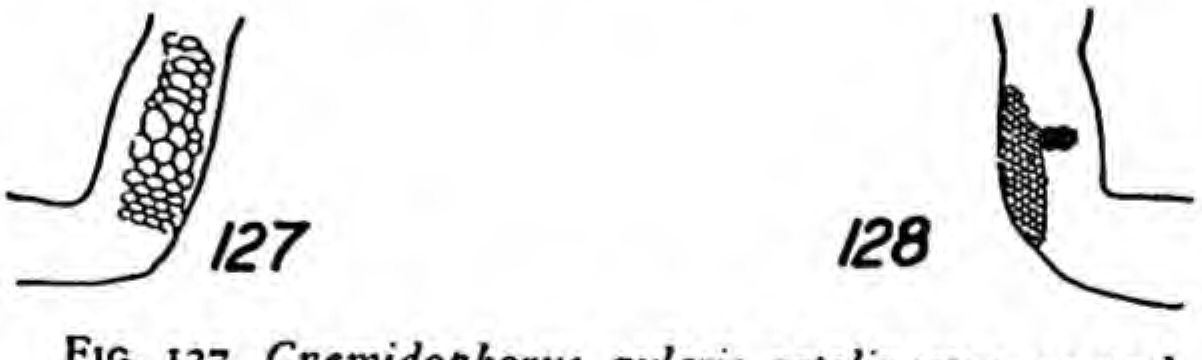


FIG. 127. *Cnemidophorus gularis octolineatus*, ventral view of left forearm. From Cope.

FIG. 128. *Cnemidophorus grahamii*, ventral view of right forearm. From Cope.

8. Enlarged scales preceding gular fold relatively large, abruptly differentiated from granular scales of fold (as in Fig. 126); dorsal pattern checkered in adults; belly never gray or black .... *grahamii* (p. 419)

Enlarged scales preceding gular fold relatively small, frequently

[1] Young only key out here; the adults key out to couplet 9.

grading into the granular scales of the fold posteriorly (as in Fig. 125) 9

9. Gular region and chest solid black in adults; young with 6 to 8 longitudinal light lines .... *tesselatus aethiops* (p. 424)
   Gular region and chest not solid black, but usually suffused with gray or mottled in adults; young with not over 4 longitudinal light lines 10

10. Gular region not gray suffused, but mottled or spotted with black .... *tesselatus stejnegeri* (p. 426)
    Gular region gray suffused, sometimes mottled or spotted in addition .... *tesselatus tesselatus* (p. 421)

The Sexlineatus Group

This is the most difficult group of the whole genus for taxonomic interpretation. The crux of the problem is in Mexico, where numerous races exist but are not properly defined. The names for United States species cannot be considered fixed until the Mexican races and species are properly known.

The group is characterized by having 4 supraoculars, 3 parietals, and 2 frontoparietals, a striped pattern on sides as well as back in the young, and moderately large scales bordering the gular fold anteriorly (Fig. 121). It occurs throughout most of Mexico, in Guatemala, and in the United States west to Arizona; it is excluded from California and Baja Balifornia.

Eastern Spotted Racerunner *Cnemidophorus gularis gularis* Baird and Girard

(Fig. 121, p. 403; Pl. 113)

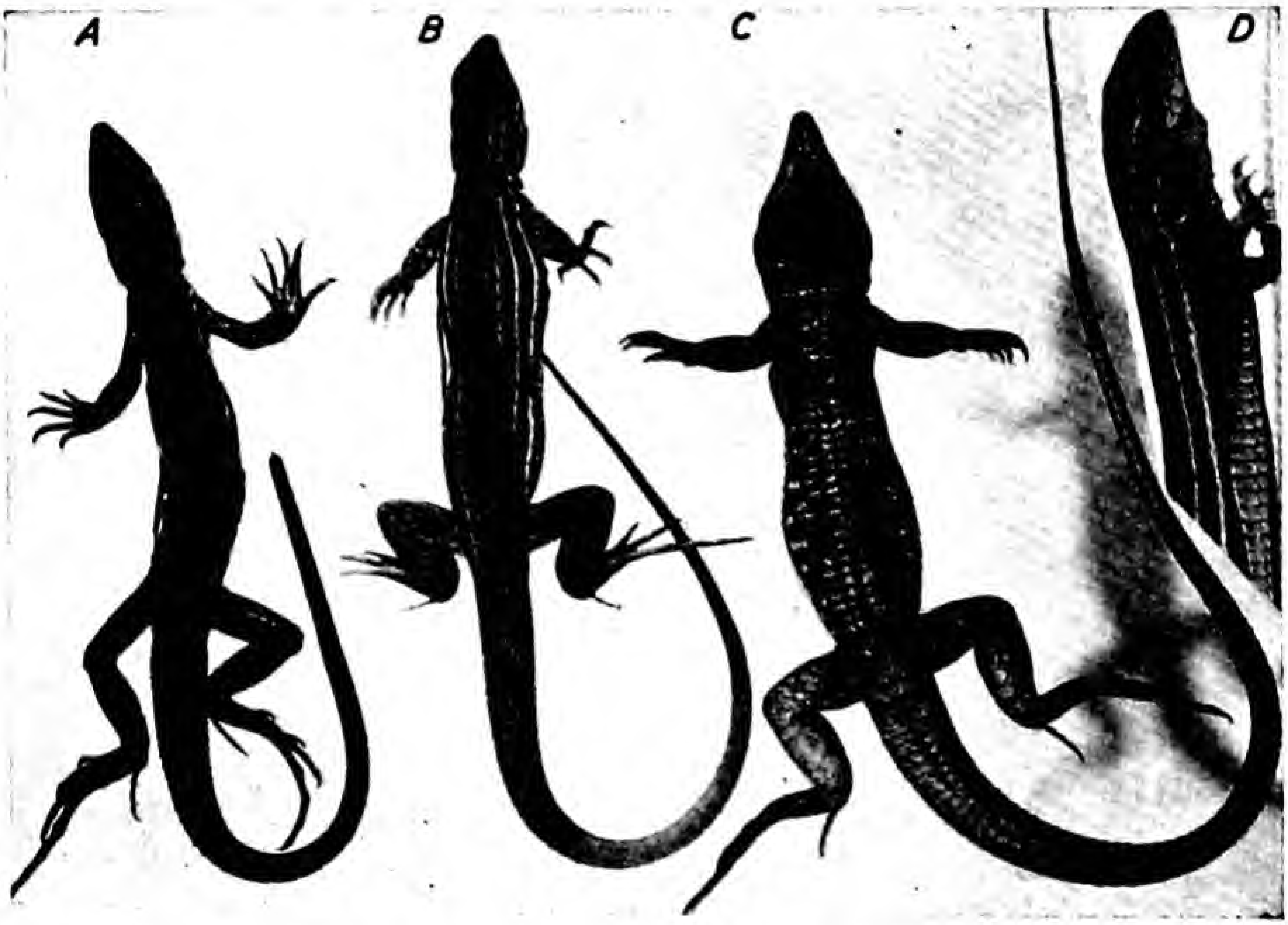
Range. Central Oklahoma south to northern Mexico, east to western Arkansas, west to eastern New Mexico. Type locality—Indianola and San Pedro River, Texas. (Map 32, p. 506.)

Size. Large specimens may measure at least 86 mm. (3⅜ in.) snout to vent, and probably a little more. The tail is long and slender, about 1⅔ to 2⅕ times the length of head and body.

Color. Six primary light lines extending from head to base of tail, as in *sexlineatus;* they are equally distinct in males and females. However, between the median stripes, in the broad middorsal area, is another light line, a little broader, less well defined, and more wavy than the other light lines; the middorsal light line is also a little darker in shade than the other light lines, and may enclose a dark streak that gives the impression of a double line. In the dark fields between the median, dorsolateral, and lateral lines on each side, longitudinal series of light spots are present in adults, although absent in the young; in general one series is present between each pair of stripes; the spots may expand considerably, but do not break up the stripes, which remain

distinct throughout life in both sexes. The limbs are mottled above. There is no very distinct light stripe on the posterior surface of the thighs. The dorsolateral light stripes continue on tail, and are bordered below by a dark stripe; below this the light ventral color begins.

Females are a more or less uniform light cream below, but males are brilliantly colored. The entire throat is orange, and most of the belly is a dark



Pl. 113. *Cnemidophorus gularis gularis.* A, Hebbronville, Texas; male. B, Somerset, Texas; female. C, Brownsville, Texas; male. D, Somerset, Texas; female.

marine blue; the posterior part of the belly is suffused with cream. The tail and ventral surfaces of limbs are cream.

Scalation. See Fig. 121. As in *sexlineatus* except dorsals about 81 to 93 from one side to the other, near middle of body; postantebrachials greatly enlarged in males, usually also in females, but the latter sometimes with only moderately enlarged scales (in all specimens these scales are smaller than in males). Femoral pores 15 to 22.

Recognition Characters. The most distinctive thing about *g. gularis* is its striking color pattern, particularly the ventral markings in males, which are not entirely reproduced in any other United States racerunner. The light spots in the dark fields between the stripes are characteristic, but *g. octolineatus* also may have these. The latter race does not have the brilliant ventral pattern

of *g. gularis* in males, however, and neither does the other race, *sexlineatus,* whose range *g. gularis* overlaps. The enlarged postantebrachials further distinguish *g. gularis* from *sexlineatus,* as does also the absence of a distinct lateral light stripe on the tail. The distinct striped pattern, remaining well defined throughout life, also distinguishes *g. gularis* from *g. octolineatus.*

Habitat. A completely terrestrial lizard, usually found in more or less dry regions in areas not covered by a heavy growth of vegetation. In dry regions the lizards may choose moist habitats, as along streams. They avoid regions with the terrain so broken by boulders that they find no flat spots in which to utilize the speed of which they are capable. Within the limits stated, these lizards are very ubiquitous, being perhaps the most common within their range. They occur in elevations up to 7500 feet above sea level.

Habits. In the Guadalupe Mountains Mosauer records:

> Everywhere around the shrubs of catclaw it could be seen restlessly wandering about with nervous, jerky movements, industriously scratching with the forelegs between dry leaves and dead bark of trees, and pushing the pointed muzzle here and there in search of food. Of all American lizards I have observed, *Cnemidophorus* in its nervous agility most reminds me of the Lacertidae of the Old World. Although these lizards were not very shy, giving no heed to one's approach to within six feet or less, they were very difficult to capture among the prickly shrubs.

In Oklahoma Ortenburger observes that the habits and actions of *g. gularis* and *sexlineatus* are very dissimilar, though the habitats are much the same. He states that "*gularis* is much slower and more deliberate in all of its movements than *sexlineatus.* When disturbed *gularis* does not run so far before it stops; it then commonly turns its head and in a leisurely manner looks all around, thus giving the collector a good opportunity to shoot."

The eggs are said to vary from 8 to 12 and are buried in sand or soft soil at a depth of from 1 to 5 inches.

Problems. Before the life histories and other features of the natural history of this and the other cnemidophori of this country are studied, it is essential that their taxonomy and variation be investigated. Burt has made an excellent contribution, showing where relationships and lines of evolution lie, but his work has not demonstrated types of pattern evolution and lines of phylogeny. Much work is yet to be done in correlating these with biotic areas. Until the geographic races of *gularis* and its relationship to what is here called *perplexus* are better known, little can be gained by natural history studies. A re-examination is needed more urgently of this genus than of any other genus in the country.

The existence of an isolated population of *g. gularis* in Arkansas, assured by Hurter and Strecker and by Dellinger and Black (*Ark.*) is worthy of investigation. There may actually be a continuity with the more western popu-

lation, but if not, the Arkansas specimens may well be distinguishable, as are some of the amphibians of the area.

If Burt is correct in believing *sackii* belongs to the *gularis* complex, as I believe he is, this race should be known as *C. sackii gularis*, and the western one as *C. sackii octolineatus*. Until, however, intergradation of the numerous vicarious forms between Oaxaca (type locality of *sackii*) and northern Mexico is proved, nothing is gained by juggling the nomenclature. As Stejneger has remarked, it is not good policy to substitute one uncertainty for another uncertainty.

References. Burt, 1931, pp. 97–121, part (*gen. lit.*); Mosauer, 1932, p. 9, habits (*N.M.*); Ortenburger and Freeman, 1930, pp. 180–181, habits (*Okla.*).

Western Spotted Racerunner *Cnemidophorus gularis octolineatus* Baird

(Figs. 126, 127, pp. 404, 405; Pl. 114)

Range. Western New Mexico and western Colorado west through Utah and most of Arizona, east through western Texas, and southward in northern Mexico. Type locality—Pesquería Grande, Nuevo León, Mexico. (Map 32, p. 506.)

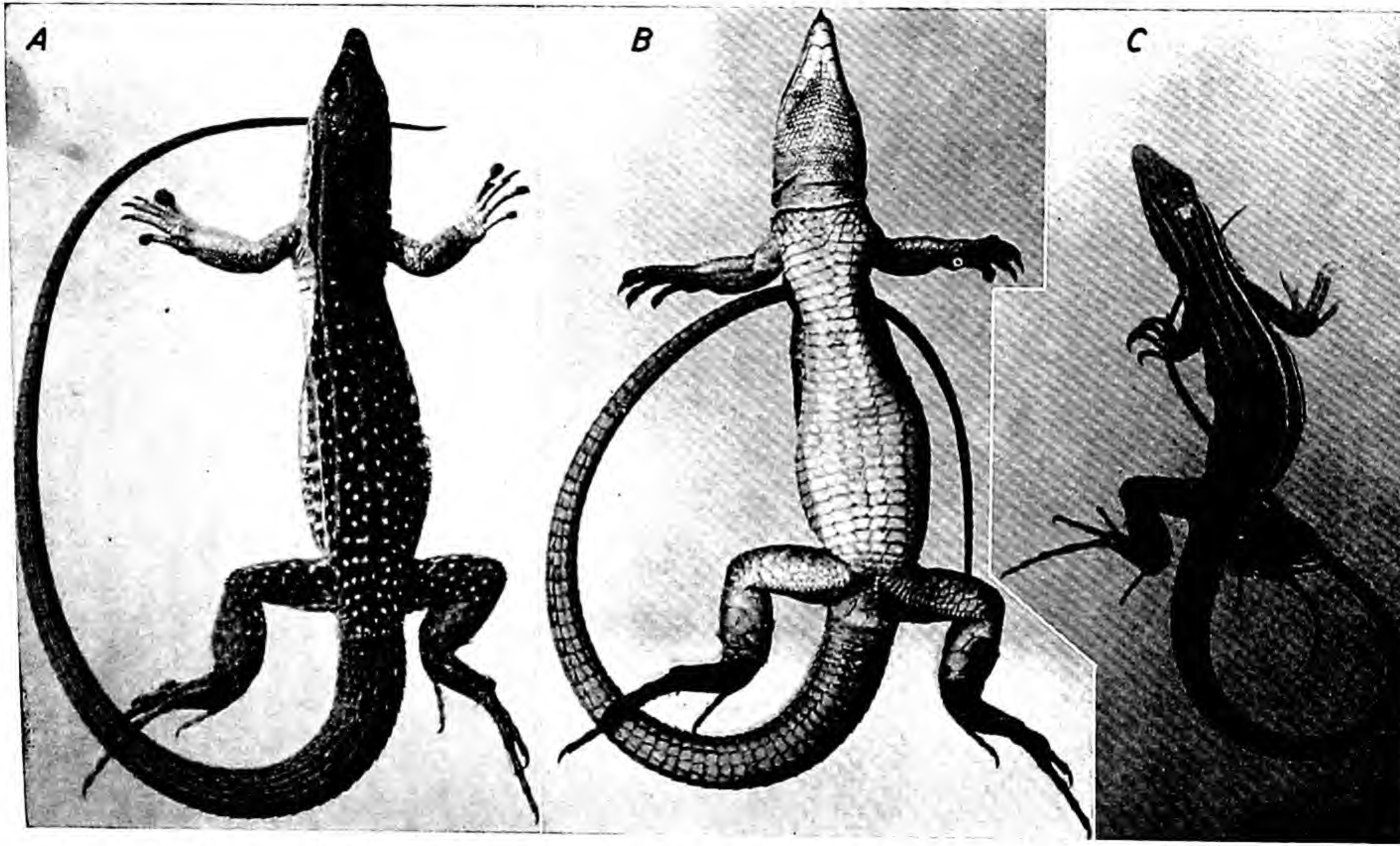
Size. A large race, reaching a maximum snout-vent measurement of about 125 mm. (5 in.). The tail is from 2 to 2¾ times as long as the head and body.

Color. In specimens of moderate or small size, the dorsal pattern is just as in the eastern race, except that the middorsal light stripe is less frequently present. In larger specimens, however, the light spots in the dark fields enlarge and break the dark fields into segments which fuse transversely to produce a crossbarred pattern. This crossbarred pattern is more evident posteriorly than anteriorly. Eastern specimens may not show as distinct a crossbarred pattern as western specimens, but this may be a reflection of size difference as eastern ones do not become as large as the western ones.

In ventral pattern this race is markedly different from *g. gularis*, and mainly on this difference are they separated. The lower surfaces remain bluish white, never developing the red throat and dark blue chest characteristic of the males of the eastern spotted racerunner.

Scalation. As in the eastern race (Fig. 121) See Figs. 126, 127.

Recognition Characters. As stated above, the chief reason for distinguishing the eastern and western races from each other is to recognize the geographical segregation of the ventral patterns of males. Since size and some dorsal pattern differences are correlated with the ventral pattern character, it does not seem unreasonable to suppose that actually these differences define two geographic races. In fact this is the conclusion at which Burt arrived. He, however, did not segregate the small species to which the name *perplexus*



Pl. 114. *Cnemidophorus gularis octolineatus.* A, B, Davis Mountains, Texas. C, Peña Blanca Springs, Arizona.

actually belongs, and thus used that name erroneously for the western race of *gularis*. So far as can be determined Baird's name of *octolineatus* is the earliest available for this race. Schmidt and Smith also regard *perplexus* as distinct, but in addition they consider *g. gularis* and *g. octolineatus* as distinct species.

Habitat. A terrestrial lizard, generally associated with canyons, foothills, and semiarid mountainsides.

At Alamogordo [New Mexico] this lizard was found only in the lower part of the cañons, and in the stony arroyos on the alluvial slopes. Its habitat is thus quite distinct from that of [*C. perplexus*] which is found only on the plains. . . . At Tucson it occurs likewise in the lower part of the cañons, and follows down the slopes to the Santa Cruz River where it is a characteristic reptile in the Willow-Poplar association on the banks.

While it thus occupies the same topographic features in the two localities, the other environmental conditions are sufficiently dissimilar to make the habitat a very different one in the two regions. This is well illustrated by the plants. At Alamogordo the vegetation consists of the Sotol, Ocotillo, various cacti, yuccas, and the habitat is a very open and arid one, while at Tucson the vegetation consists of trees and bushes, and the habitat is the most shaded and protected one below the Piñon-Cedar association. It may or may not be significant that the only specimen taken in a dry arroyo at Tucson (vegetation Ocotillo, cacti, etc.) is a "medium sized" individual with both stripes and spots, while the largest specimens were found only in the Willow-Poplar association along the streams. At any rate it is conceivable that the environmental conditions at Tucson may be more favorable for this species than those composing its habitat at Alamogordo, and thus be directly or indirectly the cause of the larger size attained by individuals in this locality. If this is the true explanation of the facts in the case it must be that the Alamogordo specimens are either inhibited from attaining a larger size by the exigencies of their habitat, or represent a dwarfed race.

In both localities *C. gularis* is strictly a ground form. At Alamogordo it is found among the rocks and clumps of yuccas, cacti, etc.; at Tucson about the bushes and weeds that form the underbrush in the Willow-Poplar association, and among the rocks in dry cañons (Ruthven).

It occurs at elevations as great as 8500 feet above sea level.

Habits. Ruthven states: "In the Willow-Poplar association it is difficult to secure owing to its shyness and the rapidity of its movements. The large individuals can often be heard several rods away rustling about in the leaves and brush, but they are almost constantly in motion and stay close to the protection of the bushes."

Nevertheless, Ortenburger records that, near Tucson, this species is much slower in its movements than *tesselatus aethiops*.

When it runs it is only for a few feet at a time and at each halt it turns to look around thus rendering it easy to capture. Sometimes even when closely pursued its gait is only a slow walk. It never darts away swiftly as does . . . [*C. t. aethiops.*]

Although this species is quite at home upon the stones and boulders, it probably

feeds exclusively upon the ground. More than once this whip-tail was seen on the sand among the boulders, eating. Its actions reminded us very much of a chicken, except that the fore feet were used for scratching rather than the hind feet. It usually made two or three scratches with one foot, backwards and laterally, and then two or three with the other foot. They were in no case observed to make alternate single strokes. After every few scratches they would stop and pick up some food by making very rapid movements, again reminding one of a chicken. They showed very little fear, for as this process was observed for some minutes in several instances, they would occasionally turn the head or the whole body and look at us, and then continue eating.

No eggs were found although a special search was made for them. One evening (July 15) at 6 P.M. a female containing well developed eggs was dug out of a freshly made hole about 1½ inches in diameter and one foot deep. This hole had been dug in the clean sand in a dry stream bed about a half mile up a canyon. There was little doubt that the female caught had dug the hole herself and possibly intended to deposit her eggs there.

The food consists largely of insects, but includes other arthropods. Data available now show no marked preference for any one type of food. No very comprehensive survey has been made, however.

Among this lizard's enemies are counted the Gila monster and numerous snakes. The leopard lizard may also prey upon it when possible, but the racerunner is so fast that according to one observer it can outrun the leopard lizards.

Problems. The marked difference in size between eastern and western specimens of the western race has not been fully explained; it may be controlled either by environmental or genetic factors. All, however, are larger than specimens of the eastern race. Very probably the western form, as here segregated, is actually composed of several races; some in Mexico seem particularly distinct.

Schmidt and Smith treat this form as a distinct species rather than a race of *gularis*. Further investigation is needed of its status.

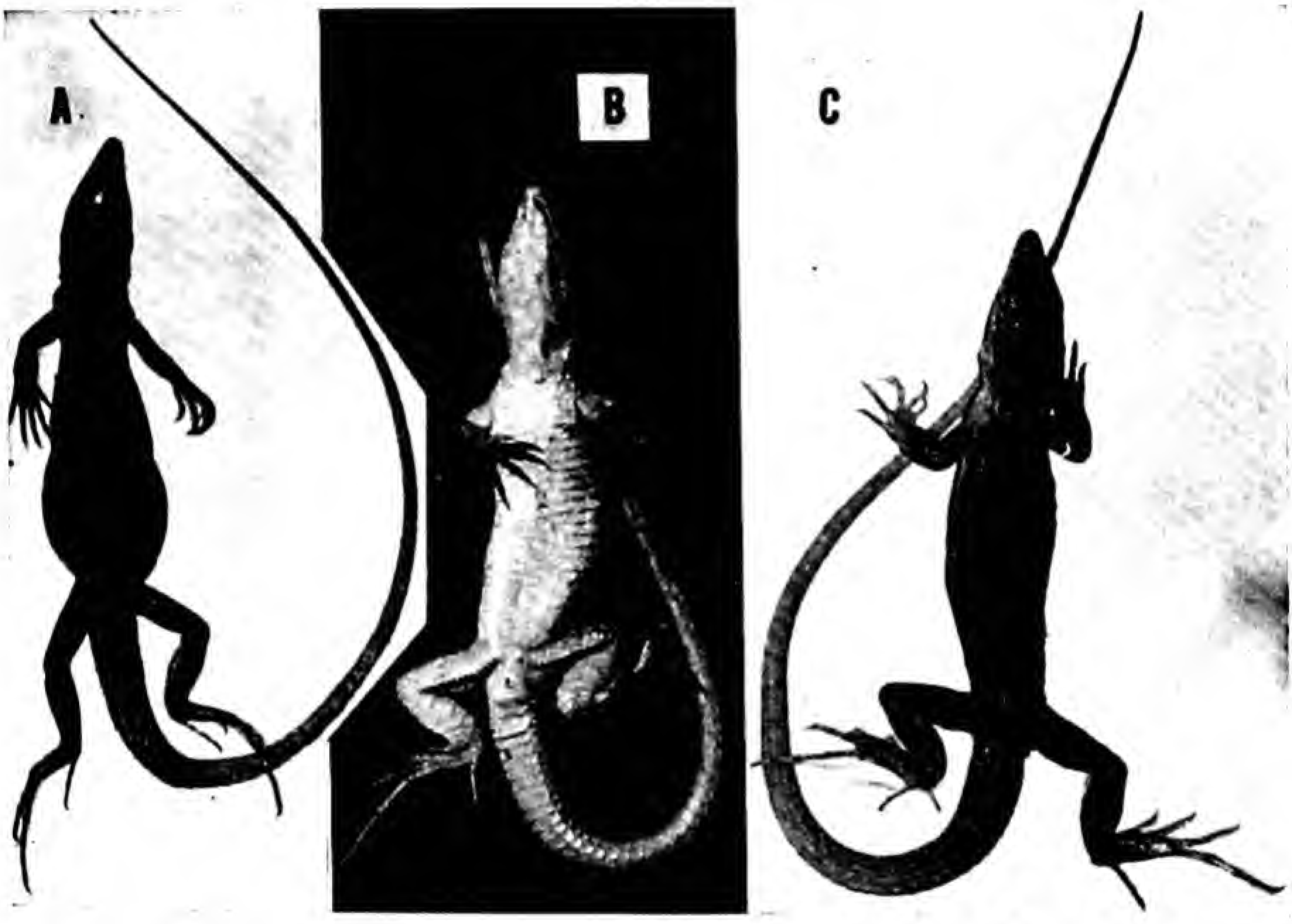
References. Burt, 1931, pp. 122–140 (*gen. lit.*); Knowlton, 1934, p. 1003, food (*lit. cit.*); Ortenburger, 1926, p. 110, habits, habitat (*Ariz.*); Ruthven, 1907, pp. 556–560, color, habitat, habits, food, Arizona and New Mexico (*Ariz.*); Schmidt and Smith, 1944, pp. 85–86 (*Tex.*).

Little Striped Racerunner *Cnemidophorus perplexus* Baird
(Pl. 115)

Range. Not well known, but including western Texas, southern New Mexico, southeastern Arizona, and a large part of northern central Mexico. Type locality—Valley of Rio San Pedro, tributary of the Rio Grande del Norte, Texas. (Map 33, p. 507.)

Size. A small species, maximum snout-vent measurement about 70 mm. ($2\frac{3}{4}$ in.). Tail probably as in other species, about twice as long as head and body.

Color. Ground color brownish, sometimes suffused with a bluish tinge. Seven continuous light stripes, the median dorsal either distinct or obscure, but usually indistinct posteriorly at least. Tail rather bright blue. Ventral surfaces white or pale bluish. No light spots in dark ground color. Pattern never broken up in adults.



Pl. 115. *Cnemidophorus perplexus.* A, El Paso, Texas; female. B, White Sands, Alamogordo, New Mexico; male. C, El Paso, Texas; male.

Scalation. Much as in *sexlineatus,* but scales in a central area on posterior surface of lower foreleg very variable, either enlarged or not. Femoral pores 12 to 18.

Recognition Characters. This species, overlapped completely by *gularis* and its subspecies, is not always easy to distinguish from the latter. I have, however, collected the two species together in the field often enough to be convinced that they are distinct. In some areas *perplexus* occurs to the exclusion of *gularis* (as in the White Sands region of New Mexico), but in other areas both occur together and in the same habitats. Whether *gularis* occurs in other areas within the range of *perplexus* to the exclusion of the latter I do not know. The two species can be distinguished in the field in color, even at small

sizes. Adult *perplexus* females, full of eggs, are found that are much smaller than egg-bearing *gularis* specimens of the same locality, and furnish very strong evidence that two species are actually involved. Yet an infallible character whereby young *gularis* lizards can always be distinguished from *perplexus,* in museum specimens, has not yet been found. Ruthven has compared the two species more carefully than any other author.

> In scutellation this species . . . [*gularis*] is distinguished with difficulty from . . . [*perplexus*]. In *C. gularis* the scales on the gular fold (especially the marginal row) are generally relatively larger than in . . . [*perplexus*], and there is always in *C. gularis* one or two rows of enlarged scales on the posterior face of the forearm (separating the minute dorsal and ventral scales) which are either absent in . . . [*perplexus*] or when present much smaller than in the former species. These characters are unsatisfactory, however, the better marked characteristics being in the coloration. These are: (1) In the adults of *C. gularis* the pattern always consists of stripes and spots as described below, while in . . . [*perplexus*] it is composed of stripes only. (2) in *C. gularis* the members of the dorsal pair of stripes are closer together than in . . . [*perplexus*] (not considering the median dorsal line), the interspace being as narrow or narrower than the adjacent lateral one in the former species, generally wider in the latter.

It is noteworthy that the femoral pores in *perplexus* are considerably fewer on the average than in *gularis*. Schmidt expresses the difference in spacing of the paravertebral stripes in another, more useful manner; according to him 6 to 9 scales separate them in *g. octolineatus,* 12 to 14 in *perplexus*.

Habitat. The name *perplexus* has been so bandied in herpetological literature that the observations on natural history that may actually refer to this species are difficult to sift free from those referring to other species. The only reference to habits or habitat which can be reliably associated with this species is that of Ruthven, who states that the species

> is a characteristic form of the desert floor habitats. In the Mesquite and Atriplex associations it was found commonly about the clumps of bushes that comprise the vegetation. On the White Sands it was also abundant, but apparently prefers the bottoms and lower parts of the dunes to the more exposed summits of the latter, being unlike *Holbrookia maculata* [*ruthveni*] in this respect. Its food consists of insects which it picks up on the ground. Ants, grasshoppers and spiders are found in the stomachs examined.

Problems. From the foregoing discussions it should be obvious that a more thorough study of the variation, relationships, distribution, taxonomy, and general natural history of this species is much to be desired.

References. Ruthven, 1907, pp. 570–573, description, habits, habitat, comparisons (*Ariz.*); Schmidt and Smith, 1944, pp. 86–87 (*Tex.*); Van Denburgh, 1922, pp. 495–497, description (*gen. lit.*).

Six-lined Racerunner *Cnemidophorus sexlineatus* (Linnaeus)

(Fig. 13, p. 62; Fig. 122, p. 403; Pl. 116)

Range. Maryland and Rhode Island through Florida, west probably to southeastern Wyoming and extreme southern Texas, north in the Mississippi-Missouri Valley to Lake Michigan, western central Wisconsin and southwestern South Dakota. Type locality—Carolina. (Map 33, p. 507.)

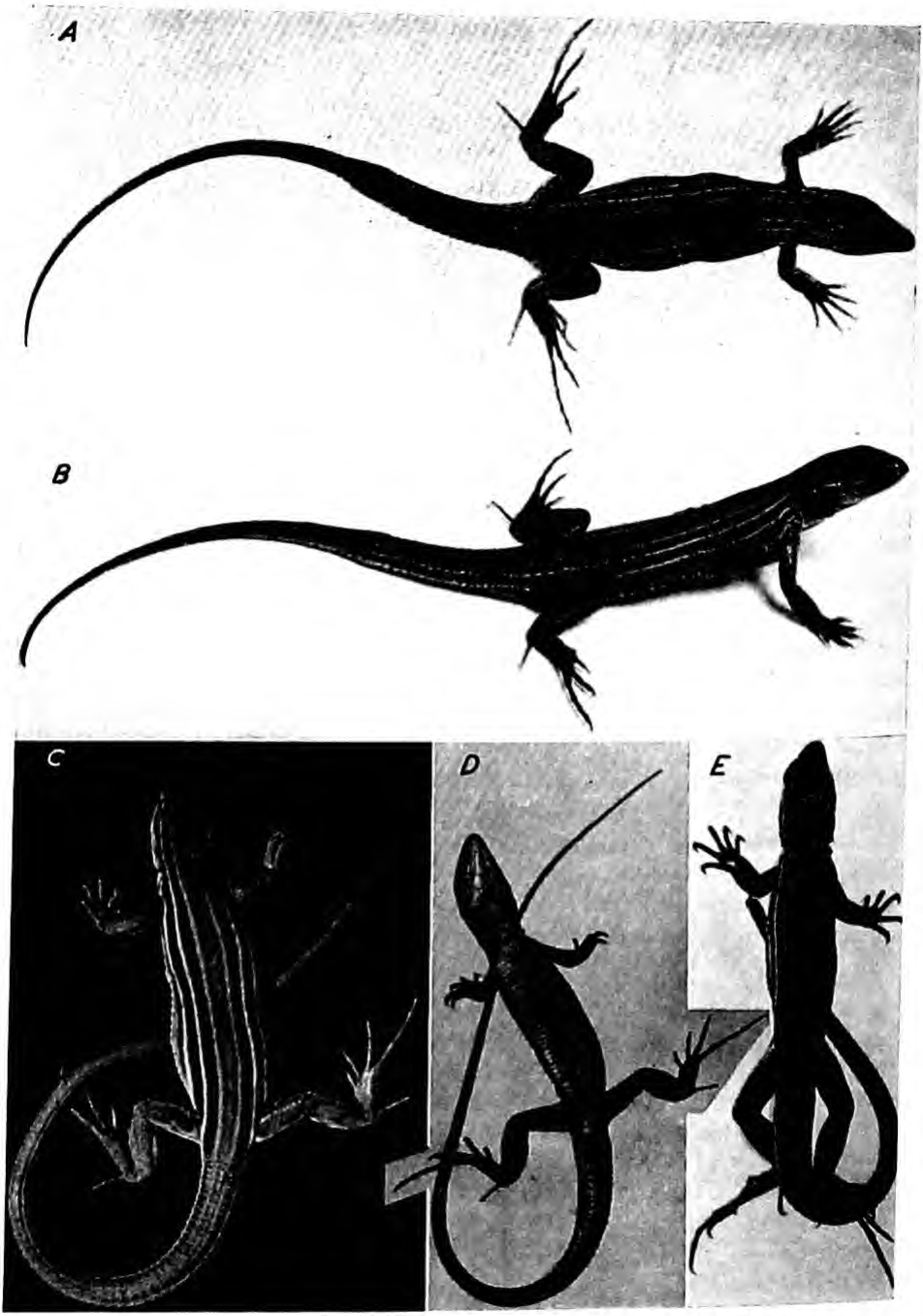
Size. Maximum snout-vent length about 75 mm. (3 in.); tail about 2⅒ to 2⅓ times the head-body length, very slender.

Color. Six well-defined, narrow, longitudinal, light, pale blue to yellowish lines on body in females and in juveniles, all extending from head to base of tail or groin; the stripe nearest the middle on each side begins near the median edge of the parietal; lateral to this another stripe (dorsolateral) begins at posterior corner of eye; and a lateral stripe begins below the eye and passes through the upper edge of the ear. Dimly evident may be another line extending from the lower part of the ear opening to the upper edge of the arm insertion. The sides between these three stripes are usually black; below the lateral stripe is a narrow dark area blending with the light ventral color; and between the median stripes is a broad brownish area. The median light stripes are indistinguishable on the tail, but the dorsolateral ones extend a considerable distance on it; bordering it below is a black stripe in turn bordered by a light stripe which extends upon the otherwise uniformly dark posterior surface of the thigh. The belly is white in life, sometimes tinged with blue in preserved specimens.

Adult males have the same dorsal pattern, except that the lateral stripes and the dark areas above them are indistinct, merged with the belly color; and the black between the dorsolateral and median stripes on each side is less intense. Ventrally the entire belly and throat are suffused with pale blue; the limbs and subcaudal surfaces are cream below. This ventral color may become blackish in formalin.

Scalation. Dorsal scales very small, granular, 76 to 93 from one side to the other at about the middle of the body (Fig. 122). Large, flat, quadrangular, belly plates in 8 longitudinal rows; 2 gular folds, the primary (posterior) overlapped anteriorly by enlarged scales. Head plates large. Scales on posterior surface of lower foreleg all small in both sexes, the central ones not, or seldom, more than 3 times as large as adjacent dorsal scales of the arm.

Recognition Characters. There is only one other lizard occurring in the same territory as the six-lined racerunner having 8 rows of enlarged ventrals, minute dorsals, big scales on the head, a long slender body and tail, and well-developed legs. This other one is *g. gularis,* which differs from the former in having usually much larger polygons on the posterior surface of the lower foreleg (sometimes but little larger in females) and a different pattern; the



Pl. 116. *Cnemidophorus sexlineatus.* A, B, Cape Henry, Virginia. U.S. Fish and Wildlife Service photographs. C, 3 miles east of Sharon Springs, Kansas. D, St. Petersburg, Florida. E, Key West, Florida; male.

dark lines contain a row of small light spots within them, and in males the throat is orange, the belly very dark blue.

Habitat. Relatively dry regions on sandy or other loose soil, in short grass, sparse woods, or areas with scattered, subxerophytic vegetation. Dryness seems more essential than any other factor; thus a loose porous soil is generally more frequented than a loamy soil, and dense vegetation, unless low and not of a moisture-retaining type, is avoided. Within these limits a tremendous variety of habitats may be and are utilized. The land may be flat or hilly, the soil rocky or uniformly fine. In the east they reach elevations as great as 1400 feet above sea level; in the west greater altitudes are attained on the high flat plains. Nowhere do they reach high elevations in mountains, however.

Habits. Moderately wary, these lizards seek cover, generally in holes or under objects such as boards, rails, stones, etc., when disturbed by close approach of an observer. They never or rarely climb; they seem completely terrestrial. If the observer remains at a distance of 15 feet or so, generally the lizards go on about their business much as usual. Although it is difficult to approach closely enough to capture them by hand before they seek cover, their habit of entering small holes or crevices frequently makes it possible to dig them out easily. They can dig their own burrows, but they do not hesitate to use mammal or other ready-made burrows. In digging they use their front legs to remove the soil. The burrows are said to extend to a depth of some 8 to 10 inches. Blanchard says the burrows have two openings; when the lizard is within, one of the openings is closed from the inside. Cook described one tunnel 12 inches long terminating in an enlarged chamber. The burrows are used as retreats during the night and on cool days, and for egg laying. How closely restricted they are to one burrow and how many are usually made during a season, is not known.

Hibernation occurs in the fall when temperatures reach a low average (October in North Carolina). Whether they use the same kind of burrow for hibernation is not known; upon emergence in April they are sometimes covered with soil, which wears off shortly.

Activity begins early in the morning on warm days and falls off during the afternoon. In late afternoon they disappear completely. Cool temperatures they find very discouraging, not appearing on cool or cloudy days. They are completely diurnal. When well warmed up they can attain a surprising speed. Hoyt measured it as 18 miles an hour.

The food consists primarily of insects but includes also other arthropods and snails. Stomach contents studies show the normal diet includes grasshoppers, crickets, spiders, ants, flies, small moths, and moth or butterfly larvae. Apparently soft-bodied insects are preferred, as beetles are not frequently found. Large butterflies, although killed, may not be eaten. Some insects, as ladybird beetles, are distasteful and are ejected promptly upon being taken

into the mouth, "and the lips are then usually wiped on the ground, the lizard displaying great discomfort" (Burt). They are said to be voracious feeders. McClellan *et al.* (*Md.*) report that they sometimes lap up ants with great avidity.

Mating occurs in spring, probably not over 2 or 3 weeks after emergence from hibernation. A regular courtship pattern is followed. The male, without stimulus from a female, rubs his cloaca on the ground by moving his hips quickly from side to side while moving in a figure eight. At various times he stops to chase others, not distinguishing between males and females. He attempts to ride their backs, nipping the skin in the neck region and scraping the back with the femoral pores. These attentions are accepted by willing females but fought off by males. Finding a receptive female, the male curls the tail under the female until the cloacas are together. He loops his body in a half coil and grasps the posterior part of the back in his jaws at the same time that one hemipenis is inserted. Copulation continues some 5 minutes, after which the female moves away.

The eggs, 4 to 6 in number, are laid from early June to middle July. About a week after deposition the eggs measure about 17 x 9.5 mm. They are laid 4 to 12 inches below the surface, frequently under some object on the surface such as a log. Cook says they frequently use mole tunnels, making small side tunnels from them in which the eggs are laid. The young hatch in early August. The pattern is said to develop only a week or so before hatching (later than in *Sceloporus u. hyacinthinus*) (Brimley).

Black snakes and collared lizards are known to eat these lizards. Probably other snakes and lizards do so at times.

Problems. Although Taylor has shown rather conclusively that *sexlineatus* and *gularis* do not intergrade, the matter has not received the study it deserves. Although more is known of the natural history of this species than of many others of this country, there are many points on which there have been no observations.

References. Brimley, 1903, p. 265, habits (*lit. cit.*); Burt, 1931, pp. 76–97 (*gen. lit.*); Cook, 1942, pp. 12–13, 18, habitats, habits (*Miss.*); Noble and Bradley, 1933, pp. 39–44, 90–91, figs. 4, 10, courtship, mating (*lit. cit.*); Taylor, 1938, pp. 520–522, no intergradation of *gularis* and *sexlineatus* (*lit. cit.*).

The Tessellatus Group

This group differs from the *sexlineatus* group largely in generally having small scales bordering the gular fold anteriorly (Fig. 125) and in having spots, crossbands, or tessellations on the sides of the young (not, however, in *t. aethiops*). It occurs in the extreme West, where the *sexlineatus* group does not occur, and overlaps the latter eastward as far as western Texas and in northern and western Mexico.

Checkered Racerunner *Cnemidophorus grahamii* Baird and Girard

(Fig. 128, p. 405; Pl. 117)

Range. Western Texas from the Panhandle through the Great Bend of the Rio Grande, southeastern New Mexico and probably adjacent Mexico. Type locality—between San Antonio and El Paso, Texas. (Map 34, p. 507.)

Size. A large female measures 97 mm. ($3^{13}/_{16}$ in.) snout to vent, but the species probably reaches a still greater size; adults are commonly 75 to 85 mm. (3 to 3½ in.) in snout-vent length. The tail is very long and slender, about 2½ to 2¾ times as long as the rest of the animal.

Pl. 117. *Cnemidophorus grahamii.* El Paso, Texas. A, C, male; B, D, female.

Color. The pattern in adults, and in half-grown specimens, consists of 6 fairly distinct stripes on a more or less uniform black background which is broken up into more or less quadrangular, irregular blotches by short, transverse, light lines crossing between the longitudinal lines. The primary light stripes are thus somewhat wavy, but they remain distinct throughout life. The broad, median, dark area is broken into 2 series of spots by transverse light lines that extend to the middorsal line but do not cross it; the lines on the two sides seldom meet and thus 2 series of dark spots, frequently coalescing at the midline, and sometimes a broken, vague, median, light stripe are evident. The sides below the lateral light stripe are also broken into more or less quadrangular blotches. The legs are mottled and spotted. There are no distinct stripes, either dark or light, on the tail; there may be an irregular light line extending along the posterior surface of the thigh.

The belly is pale blue, the throat a little lighter, in both sexes; the anterior, medial, or lateral edges of some belly scales are black, especially toward the sides of the belly and on the chest, producing an irregularly spotted pattern; there is much less dark color on even the chest, where the black is most concentrated, than light color. The sexes are marked alike.

The very young of this species are not known. Presumably 6 light lines and light spots in the dark fields would occur. The smallest specimen examined, 42.5 mm. snout to vent ($1^{11}/_{16}$ in.), possesses a pattern very nearly like that of the adults. Strecker says all the young are so marked.

Scalation. As in other *Cnemidophorus* species except that the scales on the posterior surface of the lower foreleg are all rather small, not enlarged (Fig. 128); the scales bordering the gular fold anteriorly are enlarged, usually larger than the anterior throat scales, and in a regular series bordering the granular fold (as in Fig. 126).

Recognition Characters. This is one of the most easily recognized racerunners of the United States. The peculiar broken pattern of more or less quadrangular dark spots is very distinctive; the blue, somewhat mottled belly is also characteristic. From *perplexus* and *gularis,* which occur in the same area, *grahamii* can generally be distinguished by the absence of enlarged postantebrachials. From *t. tesselatus,* which also occurs over much of the territory inhabited by *grahamii,* the latter may be distinguished by the regular, enlarged, mesoptychial scales. In *t. tesselatus* these scales are smaller (usually smaller than anterior gular scales), and those bordering the fold are of irregular size, some smaller than those preceding them. The difference, once observed, is striking. The femoral pores vary from 19 to 22.

Habitat. In the Panhandle of Texas Strecker found the species occupying a canyon habitat at the edge of the plateau. The region is grassy, hilly, and the predominant rock is sandstone. Trees are scanty.

Habits. Strecker says that the species is an active climber (on boulders, not trees), contrary to *gularis*. When disturbed these lizards would frequently

seek to escape by climbing the boulders to reach a safer spot but seldom attempted to escape by entering burrows. They could climb or descend nearly vertical rock surfaces. Sometimes they hid under slabs of stone, under which they were found coiled up in shallow depressions apparently formed in the sand by them. They were observed basking on boulders and showed a preference for one particular sunning spot. Their activity begins early in the morning (before 7:30 A.M.) and continues until nearly sundown, when they were observed lying along the western edges of boulders at such an angle as to receive full benefit of the sun's rays.

Eggs to the number of 4 to 8 are laid in early June at a depth of about 6 inches in loose sand. Strecker observed one female at 7:30 A.M. dig a burrow, using the forelegs, lay 4 eggs, and partially cover them. The specimen took alarm and fled before the process was completed.

References. Baird, 1859, p. 10, pl. 32, figs. 1–6, illustration (*lit. cit.*); Cope, 1900, pp. 598–599, fig. 117, description (*gen. lit.*); Strecker, 1910, pp. 8–13, pl. 1, habits, habitat, variation, illustrations (*Tex.*).

Common Tessellated Racerunner *Cnemidophorus tesselatus tesselatus* (Say)

(Fig. 14, p. 62; Figs. 124, 125, p. 404; Pl. 118)

Range. Eastern Oregon and southern Idaho south through eastern California to northeastern Baja California and northwestern Sonora; west to southwestern Colorado and western Texas, excluding southeastern Arizona and southwestern New Mexico. Type locality—Arkansas River, near Castle Rock Creek, Colorado. (Map 35, p. 508.)

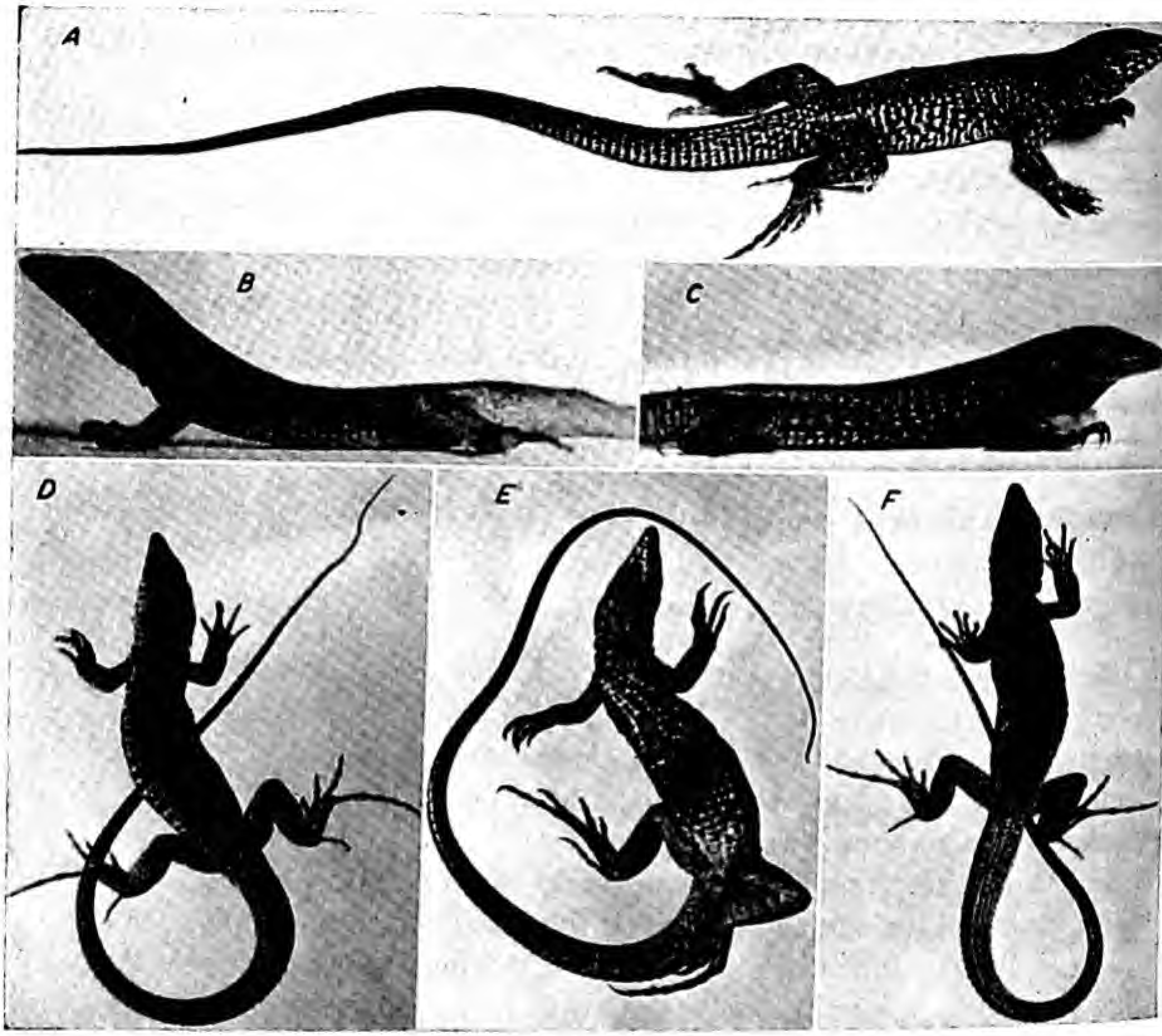
Size. Moderate; large specimens reach 95 mm. (3¾ in.) snout to vent. The tail is long and slender, about twice as long as the head and body.

Color. Pattern much broken, irregular. In very young specimens the back may entirely lack longitudinal stripes, which are replaced by small light dots medially, merging laterally with vertical light lines; or the young may have 4 fairly distinct light lines, and sometimes 1 or 2 others, dimmer, on either side. Four light stripes is the usual number of stripes, when visible; others, if present, are dim. Between these two extremes of pattern all types of intermediates occur, although Texas young are predominantly spotted or mottled, the stripes much reduced or absent, and Utah young are universally striped. The stripes are wavy, and light spots and transverse lines break the uniformity of the dark fields between them; the sides are mottled variously.

In adults some evidence of the 4 light lines may remain; if so they are most prominent anteriorly, fading or indistinguishably broken posteriorly. The sides are barred. In other specimens the entire dorsal surface is barred, the stripes not in evidence. In Texas specimens the dorsal and lateral surfaces are

more spotted and mottled than barred, although a dim barred effect is usually evident laterally.

The ventral surfaces are somewhat bluish, sometimes suffused with gray, and spotted or mottled with black. The black markings may be few and scattered, or the whole chest may be nearly black, with but few scattered light



Pl. 118. *Cnemidophorus tesselatus tesselatus.* A, Provo, Utah. U.S. Fish and Wildlife Service photograph B, San Vicente, Texas. C, Reno, Nevada. D, San Vicente, Texas; male. E, near Baker, California; male. F, Reno, Nevada.

scales; the throat may be heavily suffused with gray, on which may be some black spots, but it is never a uniform black.

Scalation. See Figs. 124, 125. Postantebrachials never enlarged (as in Fig. 125); mesoptychials never enlarged as much as in *gularis* and its relatives, irregular in size, not with a row of uniformly enlarged scales bordering the anterior edge of the gular fold; scales around middle of body, excluding ventrals, over 85. Femoral pores 17 to 25.

Recognition Characters. The first two scale characters mentioned above will

usually suffice to identify specimens of this species. Certain *perplexus* specimens, however, have the same scale characters, and these are best separated by pattern or by the less than 85 dorsal scales in a transverse row between the belly scales. From *t. aethiops* and *t. stejnegeri* the race is distinguished solely by color pattern; see the discussion of these races for comparisons.

Habitat. Numerous published accounts reveal a very wide choice of habitat, from below sea level to about 7000 feet above. A fine soil is preferred to coarse, and hard-packed to loose sand. These lizards are found on open deserts far from water, or along streams in grass. Rocky hillsides and canyons are inhabited if flat areas are interspersed.

Habits. The species is one capable of very high speed when running, and it is rather wary. When disturbed it runs a considerable distance and characteristically stops to look just before slinking into a bush, from which it usually emerges on the opposite side, heading toward other bushes if further pursued. Its knack of keeping some bush between the observer and itself is almost uncanny. Refuge may be taken in holes or under objects when it is hard pressed, but rarely if ever does it climb to escape. In fact it seems incapable of climbing, like many other lizards. When running the tail is lifted from the ground; at other times it drags.

Ordinary foraging movements are nervous and jerky, interspersed with frequent pauses. Activity begins early in the morning, except in cooler regions. Like most other lizards, in the hot desert they are less active during the late morning and afternoon.

Hibernation takes place as temperatures average about 65° F. or a little less, at least in southern California. They are found buried under the soil at depths of from some 3 inches to 1 foot. At usual winter temperatures they are capable of co-ordinated, though torpid, motions. Emergence is later in cold regions and in high elevations than in warm, lower areas. In southern California hibernation continues for about 3 months, from middle November to middle February.

Mating occurs in June, and the eggs, 2 to 4 in number, are laid in the first half of July, hatching, after an incubation period of some 30 to 35 days, in August. The eggs presumably are deposited several inches below the surface in excavations made by the female. The burrows are made by use of the forefeet, several strokes with one foot alternating with several by the other. After removing a quantity of soil, the lizard turns around in the depression and pushes the loosened soil away from the entrance. This is repeated until the burrow is finished.

Problems. This wide-ranging race almost certainly comprises two recognizable, geographic forms; the Texas specimens seem most notably different from the others. In spite of numerous scattered references to the species, very little is known of its life history.

It is extraordinary that the type locality should be removed a considerable

distance from the known range of the species. It is not impossible that the name is incorrectly applied; if it actually is correctly applied, then the type locality probably is not correctly stated.

References. Burt, 1931, pp. 146–199, several species and subspecies included (*gen. lit.*); Cowles, 1941, p. 132, hibernation (*lit. cit.*); Linsdale, 1938, p. 28, activities, habits (*Nev.*); Little and Keller, 1937, p. 220, food (*N.M.*); Pack, 1923, pp. 85–90, food (*lit. cit.*); Ruthven and Stuart, 1932, pp. 1, 3, incubation period (*lit. cit.*); Van Denburgh, 1922, pp. 508–516, pl. 53, description, habits, habitat (*gen. lit.*).

For more detailed notes on food, see Knowlton, 1934, p. 1003; *idem*, 1938, p. 238 (*Utah*); Knowlton and Janes, 1932, p. 470; *idem*, 1933, pp. 1015–1016; *idem*, 1934, pp. 13–14; Knowlton and Thomas, 1934, p. 259; *idem*, 1934, p. 264 (all *lit. cit.* unless otherwise specified).

Black-chested Racerunner *Cnemidophorus tesselatus aethiops* Cope (Pl. 119)

Range. Central and southern Sonora, northward to southeastern Arizona and western New Mexico. Type locality—Hermosillo, Sonora. (Map 35, p. 508.)

Size. Moderate; large adults seldom over 95 mm. (3¾ in.) in snout-vent length; the tail is long and slender, about 2 to 2¾ times as long as the head and body.

Color. Young with 7 or 8 distinct light lines, normally a median pair but this sometimes coalescing to form a single stripe and thus a total of 7; dark fields between stripes not broken or spotted.

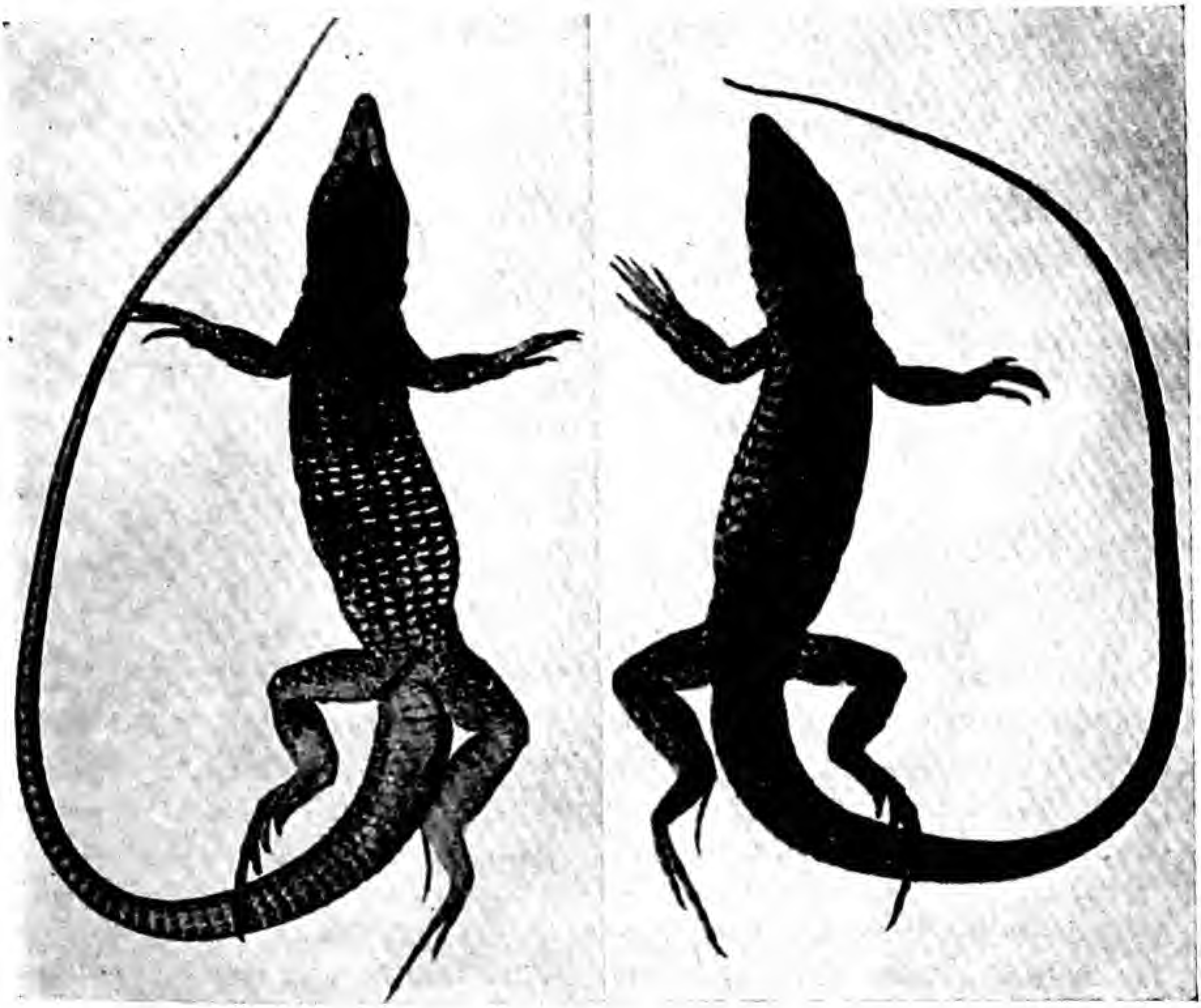
In old specimens the lines become dimmer and may be lost entirely. In the dark fields of the dorsal area between the dorsolateral stripes small light spots appear; these may coalesce slightly with each other, but for the most part they remain throughout life as separate spots; these also may nearly disappear in large specimens. Light spots also develop in the dark fields below the dorsolateral light stripes, but these become larger, expanding laterally, breaking through the longitudinal stripes, and fusing with each other, producing a barred pattern on the sides.

The chest and throat are jet black and without any light spots whatever in adults, excluding only the infralabials which are sometimes lighter. The posterior part of the belly usually is lighter, generally pale blue; the posterior part of the ventral surface of the hind legs, the preanal region and median subcaudal surface are cream. In very old specimens the entire ventral surface of the body is black, and most of the subcaudal surface as well.

Scalation. As in *t. tesselatus.*

Recognition Characters. The center of this race, where it occurs in its most typical form, is in Sonora. The young look much different from those of *t. tesselatus* and, in fact, resemble in pattern the *perplexus* that occurs in the

nearby areas. Much confusion between *gularis* and *tesselatus* in Sonora and southeastern Arizona is evident both from the literature and from museum specimens. Considerable caution must be used in this area not to confuse the young of these two species; reference should be made to the character of the postantebrachials and the mesoptychials, neither of which are enlarged in *tesselatus* as in *gularis*. The former also has more numerous dorsals across the



Pl. 119. *Cnemidophorus tesselatus aethiops.* Stockton Pass, Arizona; male.

back than the diminutive *perplexus* specimens that sometimes have small mesoptychials and postantebrachials.

The closest relative of *t. aethiops* is *t. tesselatus,* which borders and intergrades with it to the north. The young of the two races are easily distinguishable, the latter having only 4 distinct light stripes, if any, *t. aethiops* having 6, 7, or 8; also the young of *t. tesselatus* have the dark fields broken or spotted and the sides barred, whereas in the southern race both the dark and light stripes are continuous, unbroken.

Adults of the two races differ chiefly in the color of the chest and throat; in *t. aethiops* they are entirely and uniformly black; in *t. tesselatus* they are mottled; if the chest is black, usually there are a few light scales here and

there, and the throat, although sometimes gray and mottled, is never a uniform black. In parts of Arizona intermediate specimens occur, as is to be expected between geographic races. There are also differences between the adults of these two races in dorsal pattern, but these are less easily defined.

Obviously the name *melanostethus,* based upon mottled specimens from the Colorado River, cannot apply to this race; mottled gray throats and heavily mottled chests occur sporadically throughout much of the range of *tesselatus;* specimens from the Colorado River frequently show this condition. But this is not at all like the true black-chested race, which does not even approach the Colorado River. The name *t. aethiops,* based on typical Sonora specimens, must be used for it.

Habitat. This has been recorded only for the Tucson region, where, according to Ruthven it "is common and of general distribution on the Greasewood plains. It is also found in the Creosote bush association in the arroyos, and much less commonly in the Sahuaro-Ocotillo association of the hills." Ortenburger regards it as "the dominant lizard of the mesquite association of the desert floor and also on the low cholla-covered ridges west of the Cañada del Oro. This form never occurred up in the canyon more than half a mile."

Habits. "In contrast to *C. gularis* [*octolineatus*] this lizard runs very swiftly. When disturbed it seldom runs less than 15 or 20 feet and often several times this distance, particularly when vegetation is scanty. Almost always they run to the clumps of woods for protection, hiding on the opposite side from the pursuer" (Ortenburger).

The food, as indicated by stomach contents, consists of ants, beetles, grasshoppers, and spiders; no doubt many other kinds of arthropods are eaten. In turn it forms a part of the diet of other reptiles such as the leopard lizard, whip snakes, rattlesnakes, etc.

Problems. The range limits of this subspecies are not well known, especially toward the north, where it intergrades with *t. tesselatus* over a broad area. The natural history is poorly known. By pattern the race appears to be the most primitive of the group, approaching as it does the characters of the sexlineatus group.

References. Ortenburger, 1926, p. 111, habits (*Ariz.*); Ruthven, 1907, pp. 560–569, habits, habitat, color (*Ariz.*); Van Denburgh, 1922, pp. 529–533, description, localities (*gen. lit.*).

Western Tessellated Racerunner *Cnemidophorus tesselatus stejnegeri* Van Denburgh

(Pl. 120)

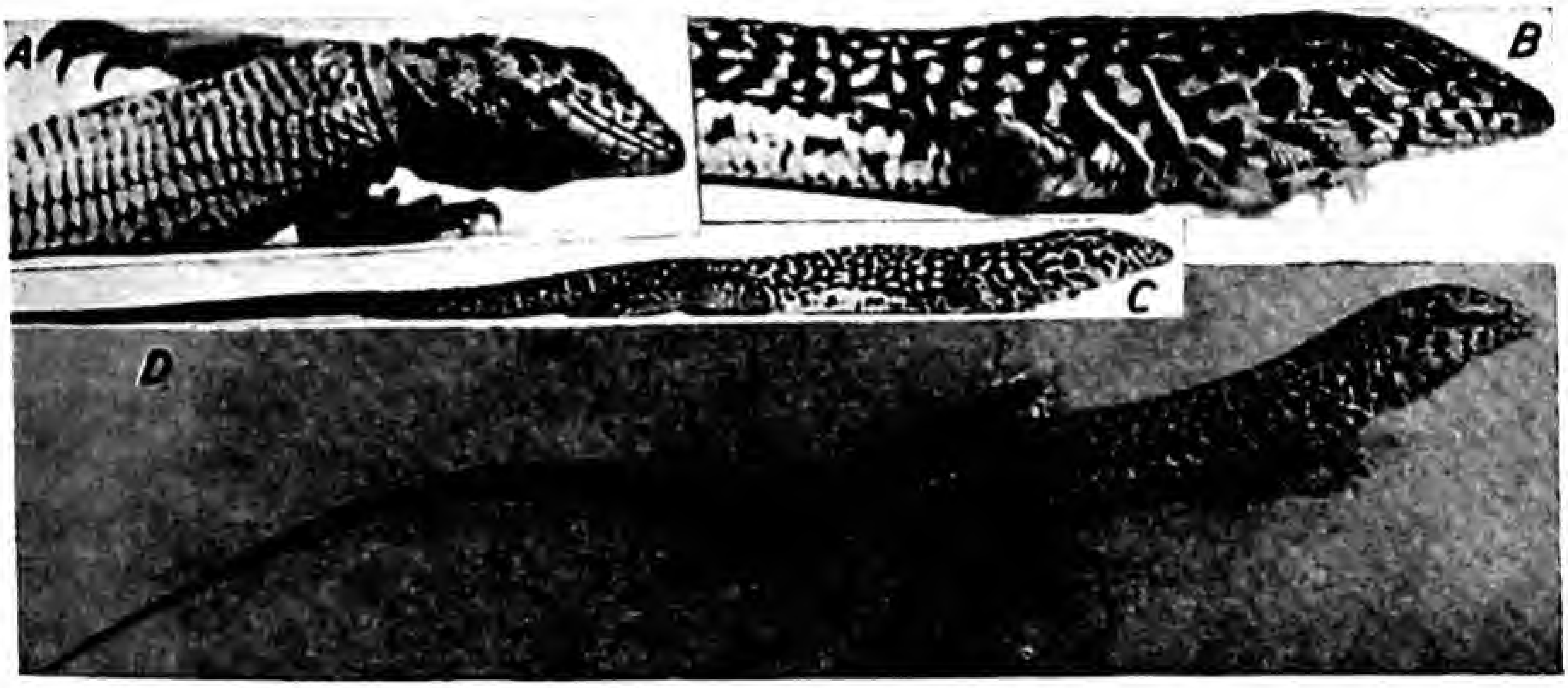
Range. Central and southern California west of the Coast Range south of Lat. 39° N., and the San Joaquin Valley; the northern half of Baja California. Type locality—near Ensenada, Baja California. (Map 35, p. 508.)

Size. Maximum snout-vent measurement 105 mm. ($4\frac{1}{8}$ in.); tail $2\frac{1}{3}$ to $2\frac{1}{2}$ times as long as head and body.

Color. Much as in *t. tesselatus*, with a stronger tendency toward formation of quadrangular blotches between the four dorsal light stripes. Body often crossbarred, with faint evidence of dorsolateral light stripes, which are usually most distinct anteriorly. Belly spotted; distinct dark scattered spots on throat, which is not suffused with gray; distinct black marks on sides of head.

Scalation. As in *t. tesselatus.*

Recognition Characters. As in *t. tesselatus*, from which it is distinguished chiefly by the distinct spotting on the sides of the head and the sharply de-



Pl. 120. *Cnemidophorus tesselatus stejnegeri.* A–C, 23 miles west of Fresno, California; male. D, Santa Barbara County, California. Gloyd photograph.

fined, black, gular marks. It is a poorly defined subspecies, but well segregated geographically.

Habitat. Sea level to about 5000 feet, in habitats much like those selected by the "common" race.

Habits. As in the "common" race. Klauber states that at higher elevations it is observed to show the effect of its desert origin, for it comes out later in the season than most of the reptiles of the area and remains more active during the hot summer. Thus at White Eagle, Campo, and Descanso, San Diego County, I have seen this subspecies active amongst the chaparral at noon on warm days when all other lizards had sought their cool retreats.

In the Lassen Peak region in the extreme northern part of its range, one specimen was recorded with 5 eggs in its stomach, which it had presumably robbed from the "nest" of some other lizard. The species to which the eggs belonged could not be identified. In the same area three females were recorded with 3 eggs each in the abdomen.

Problems. Whether *mundus*, which I have united here with *t. stejnegeri*,

should be distinguished as another geographic race I am not certain. Some authors would recognize extreme southern specimens as *t. stejnegeri,* uniting the northern specimens (*mundus*) with *t. tesselatus.* The whole matter is in need of revision.

References. Grinnell, Dixon, and Linsdale, 1930, pp. 147–148, habits (*Calif.*); Klauber, 1939, p. 99, habits, habitat (*Ariz.*); Van Denburgh, 1922, pp. 516–523, pl. 54, description, habits, localities (*gen. lit.*).

The Hyperythrus Group

This group, because of its peculiar character of having only 1 frontoparietal (Fig. 123), was once considered a separate genus, *Verticaria.* Because the character is not infallible and because of great similarity to other racerunners, the genus was abolished.

Orange-throated Racerunner *Cnemidophorus hyperythrus beldingi* (Stejneger)

(Fig. 123, p. 404; Pl. 121)

Range. Pacific coast of southern California and northern Baja California, from southwestern San Bernardino County south about to Rosario or perhaps farther; Cedros Island. Type locality—Cedros Island, Baja California. (Map 32, p. 506.)

Size. Maximum snout-vent measurement 68 mm. (2⅝ in.). Tail very elongate, when complete about 3 times as long as head and body.

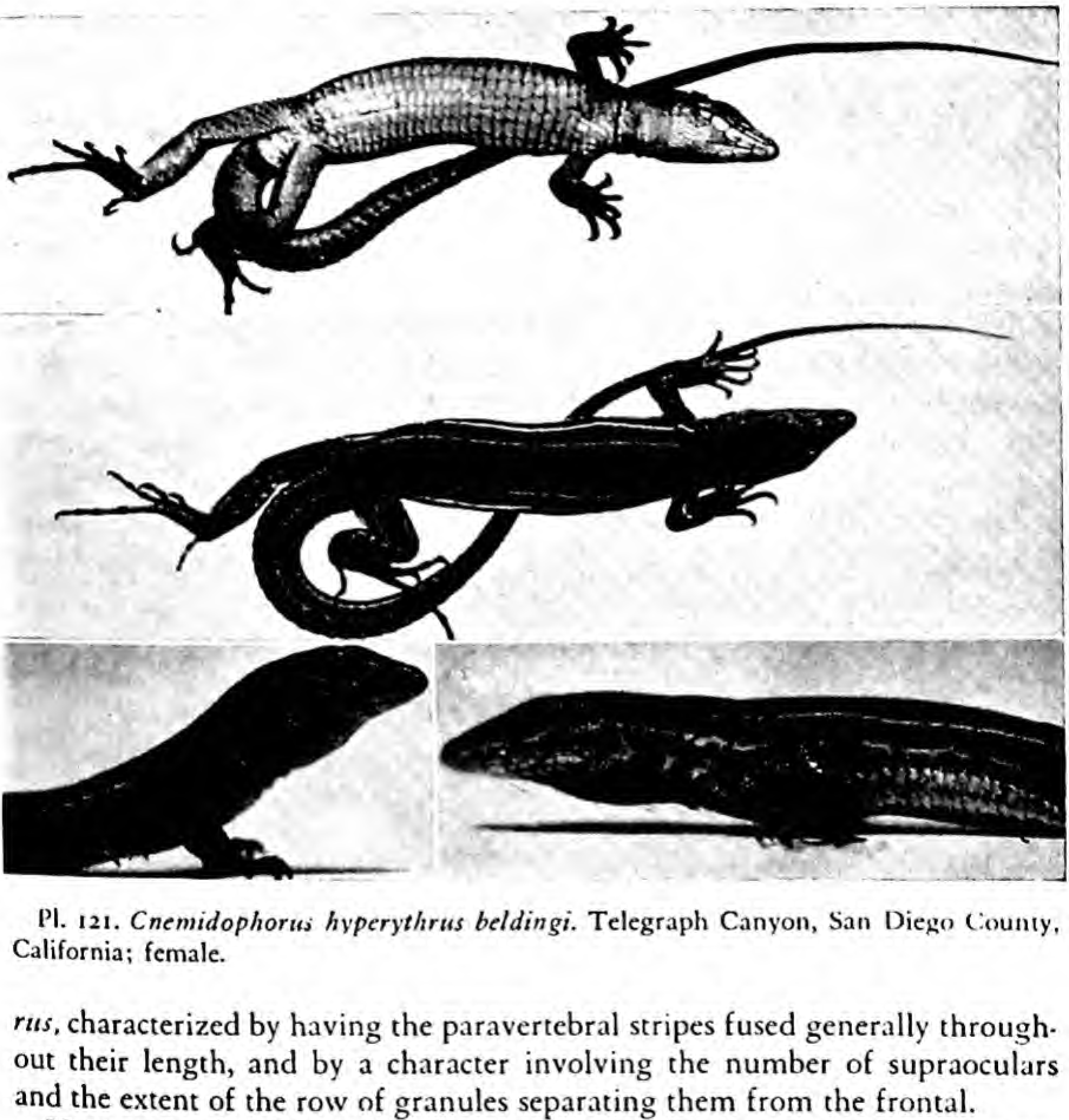
Color. Ground color dark brownish gray, almost black in some specimens, lighter between the paravertebral light lines and on sides below the lateral light lines. A paravertebral light line on either side, closely approximating and frequently uniting posteriorly, sometimes dim; a dorsolateral light line extending posteriorly from upper posterior corner of eye; a lateral light line, extending from labial region through upper margin of ear opening to groin. These light lines are scarcely evident on the tail. Posterior surface of thighs mottled or with a longitudinal light stripe, bordered above and below by dark color. Tail bright blue in young specimens. Belly whitish, sometimes bluish in adults.

Scalation. Dorsal scales very small, uniform; large, rectangular, belly plates in 8 longitudinal series; head scales large, regular; 1 frontoparietal (not 2) (Fig. 123); 13 to 16 femoral pores on each side.

Recognition Characters. From other members of this genus the orange-throated species may easily be distinguished by the presence of only 1 frontoparietal instead of 2. The only other species occurring in the same area is *tesselatus,* which is easily distinguished in pattern since it has irregular, nu-

merous lines or else has them broken up, sometimes forming crossbands. In *hyperythrus* there are 6 very distinct light lines, straight and unbroken, separated from each other by uniform dark areas.

In Baja California the race *h. beldingi* is replaced first by *h. schmidti,* in which the two paravertebral light lines are fused together over usually at least two thirds of the length of the body. Farther south occurs typical *h. hyperythrus,*



Pl. 121. *Cnemidophorus hyperythrus beldingi.* Telegraph Canyon, San Diego County, California; female.

characterized by having the paravertebral stripes fused generally throughout their length, and by a character involving the number of supraoculars and the extent of the row of granules separating them from the frontal.

Habitat. Sand and loose soil from sea level perhaps to 1400 feet, in regions overgrown with brush.

Habits. Said to be very wary. The movements normally are short and jerky as in other species; when disturbed flight is rapid and generally directed into heavier brush or holes. As a rule they forage only near cover and do not wander extensively in open spaces.

In Baja California, Trevis records that

at the Hamilton Ranch, orange-throated racerunners were abundant on the cultivated hillsides, where a prickly, xerophytic type of mixed brush gave dense cover. The lizards lived in holes whose entrances measured about 1½ inches wide and 1 inch high, and in the early morning they were often seen pushing out earth with the front feet from within these holes. They were most active in the morning and early afternoon, when they were foraging under the edges of the brush clumps. If disturbed, they took refuge either in the holes or brush. The conspicuous bright yellow dorsal lines tended to obliterate the body outline of a motionless lizard.

The racerunner and the gridiron-tailed lizard were the two most frequently seen reptiles on the peninsula. Often they were abundant at the same locality, as at Coyote Bay, but whereas the gridiron-tail would venture into the open, the racerunner always stayed under cover.

Mating has been observed during July.

Whip snakes and the larger species of *Cnemidophorus* are known to feed upon these lizards on occasion.

Problems. Not all authors agree upon the distinctness of the races *h. beldingi* and *h. schmidti;* some consider them the same and use the name *hyperythrus hyperythrus.* Linsdale as well as Van Denburgh shows the validity of the races, but a thorough summary and analysis of variation are much to be desired.

The natural history of the species is very poorly known.

References. Burt, 1931, pp. 226–240, taxonomy, description, localities (*gen. lit.*); Linsdale, 1932, p. 373, taxonomy (*lit. cit.*); Tevis, 1944, pp. 15–16, habits (*lit. cit.*); Van Denburgh, 1922, pp. 560–563, pl. 55, description, variation, range (*gen. lit.*).

The Ringed Lizards

Family AMPHISBAENIDAE

Few lizards look less as if they belonged to the Sauria than do those of this family. The body is elongate, of nearly uniform diameter throughout. The external limbs are absent (except in one genus), and the tail is usually short. There is no ear opening and the eyes are concealed under the skin. The body and tail are encircled by narrow rings of flat scales. Altogether the resemblance to an earthworm is very great.

The family ranges from South America north to Baja California and Arizona, and from Africa to the Mediterranean region; a single species is isolated in Florida. More genera and species are known from Africa than elsewhere. Thirteen or fourteen genera are recognized at present, by conservative estimate; the number of species included is nearly one hundred. In the United States only two genera occur. The most striking modifications externally are in the presence or absence of forelegs and preanal scales, the development of spines on the tail, and in the shape of the head. Very weird shapes have been developed in the heads of some species such as *Baikia somalica* and *Agamodon compressus* of Africa.

All species are burrowers. "They bore narrow galleries in the earth, in which they are able to progress backwards as well as forwards. On the ground they progress on a straight line, by slight vertical undulations, not by lateral movements, as in other limbless reptiles; the tail of many species appears to be more or less prehensile" (Boulenger, 2: 430, *gen. lit.*). Some species lay eggs (some only one, extremely elongate), others give birth to the young.

The Two-legged Worm Lizards

Genus *BIPES* Latreille

This is the only genus of worm lizards that has legs. Only the forelegs are visible, however, and these are very short and placed far forward, just behind the head. The genus occurs in western Mexico, where it is represented by three known species. Whether it is one of these species that enters southern Arizona—in fact, whether the species belongs to this genus at all or whether

it even exists—cannot now be stated. Very probably, however, the species is none of the three now known.

Some authors have preferred to place the legged worm lizards in a family (Chirotidae) separate from the Amphisbaenidae. The action seems unwarranted, since limbs or their girdles or both are represented, at least internally,

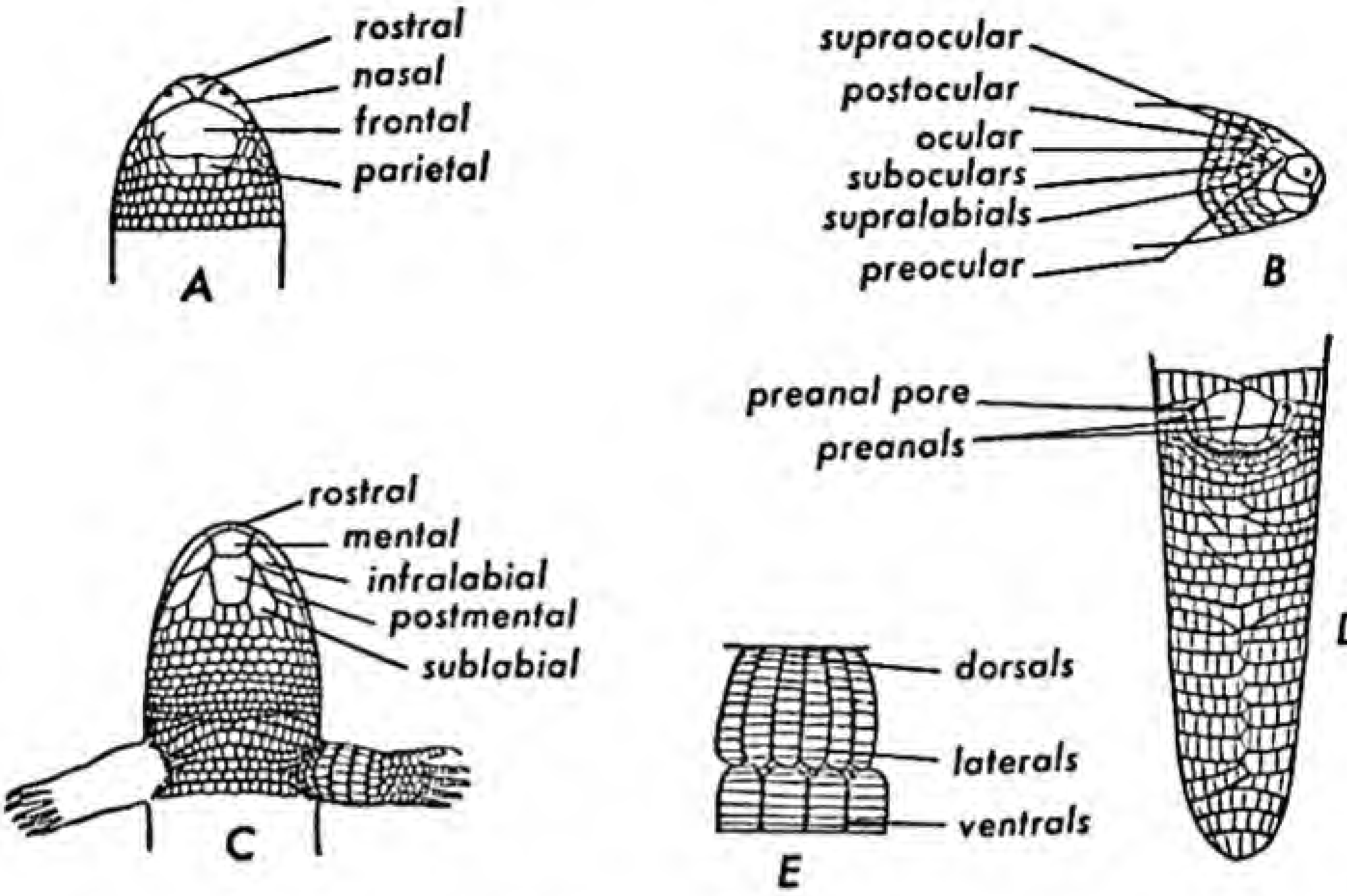


FIG. 129. Typical scutellation in *Bipes*, from *Bipes biporus*, Baja California. A, top of head; B, side of head; C, underside of head and chest; D, ventral view of anal region and tail; E, section of side of body. From Cope.

in most if not all species of the family. Otherwise the two groups are much alike. Each of the three known species of the genus has been considered by some authors to represent separate genera, which are distinguished from each other by the number of preanal pores (2, 4, or 6), by the number of digits (3 to 5), and by a number of other minor characters. The generic distinctions are not warranted. Some features of the scalation of a typical species are shown in Fig. 129.

Arizona Worm Lizard *Bipes?* species?

Range. Suspected to occur in southern Arizona. (Map 34, p. 507.)

Size. Probably around 7 to 9 inches in length.

Color. Probably uniform yellowish brown.

Scalation. Unknown. Probably somewhat similar to that shown in Figs. 6 and 129.

Remarks. Taylor has given a stimulating account of the evidence indicating the existence in Arizona of some unknown member of this genus.

During my collecting in southeastern Arizona during the summers of 1928–1930, and again in 1934, I have searched in vain for a species of *Bipes* which I believe inhabits southeastern Arizona. My first reason for this belief was based upon the statement of a placer-gold miner, in Ash Cañon in the Huachuca Mountains. He said that he had occasionally dug from the sand and gravel along the small creek in the cañon, "a small snake 10–14 inches long with two small legs near its head. They were purple or brown in color."

In another nearby cañon, I visited Dr. Biedermann, then nearly ninety years of age, who had lived more than thirty years in the Huachucas and had made extensive collections of Lepidoptera for the museums of the world. He told me that there was "a rare *chirotes* living in the mountains," and that he believed he had one preserved. However, on examination of his small collection of reptiles the specimen could not be found.

While collecting on Mount Lemon, in the Santa Catalina Range, I stopped at a small hotel near the summit. Mrs. Westbrook, the owner, warranted that I had found no snake like one she had found and kept for a pet. "It had a pair of legs coming out where its ears should be." It was found in the garden in the evening during a rainstorm. She had kept it for three months and it had escaped. Others vouched for the story, having seen the captive specimen.

The forest guard at the outlook station on Mount Lemon, told me that he had found in the Huachucas a specimen of a snake with "two legs on its neck. It was lavender and white below. The legs were so short that it didn't seem to use them to walk on." Although a collector of snake skins as a hobby, he had not preserved the skin of the specimen, because it was too small.

Mr. Doty, of the Forest Service, whom I had met on Mt. Lemon in 1934, told me that some months previously, his workers had killed three two-legged snakes while removing piles of rocks in order to drill post holes for the telephone poles. He took me to the exact place. A day was spent in the vicinity but none was found. It was extremely dry at this time. It had been raining when they were killed.

I do not believe that all of these reports have been fabricated, and all seem to point to the same animal. It seems almost beyond question that a species of *Bipes* occurs in southeastern Arizona, at least in the Huachucas and the Santa Catalina Mountains, a real prize for some collector who will put forth the necessary effort to discover it.

Reference. Taylor, 1938, p. 202 (*Ariz.*).

The Florida Worm Lizards

Genus *RHINEURA* Cope

The most unique feature of this genus, among a family full of unique features, is the flattening of the dorsal surface of the tail, which is provided above with tubercular scales. Only one living species is known, but several fossil

species have been described from central United States. Some features of its scalation are shown in Fig. 130.

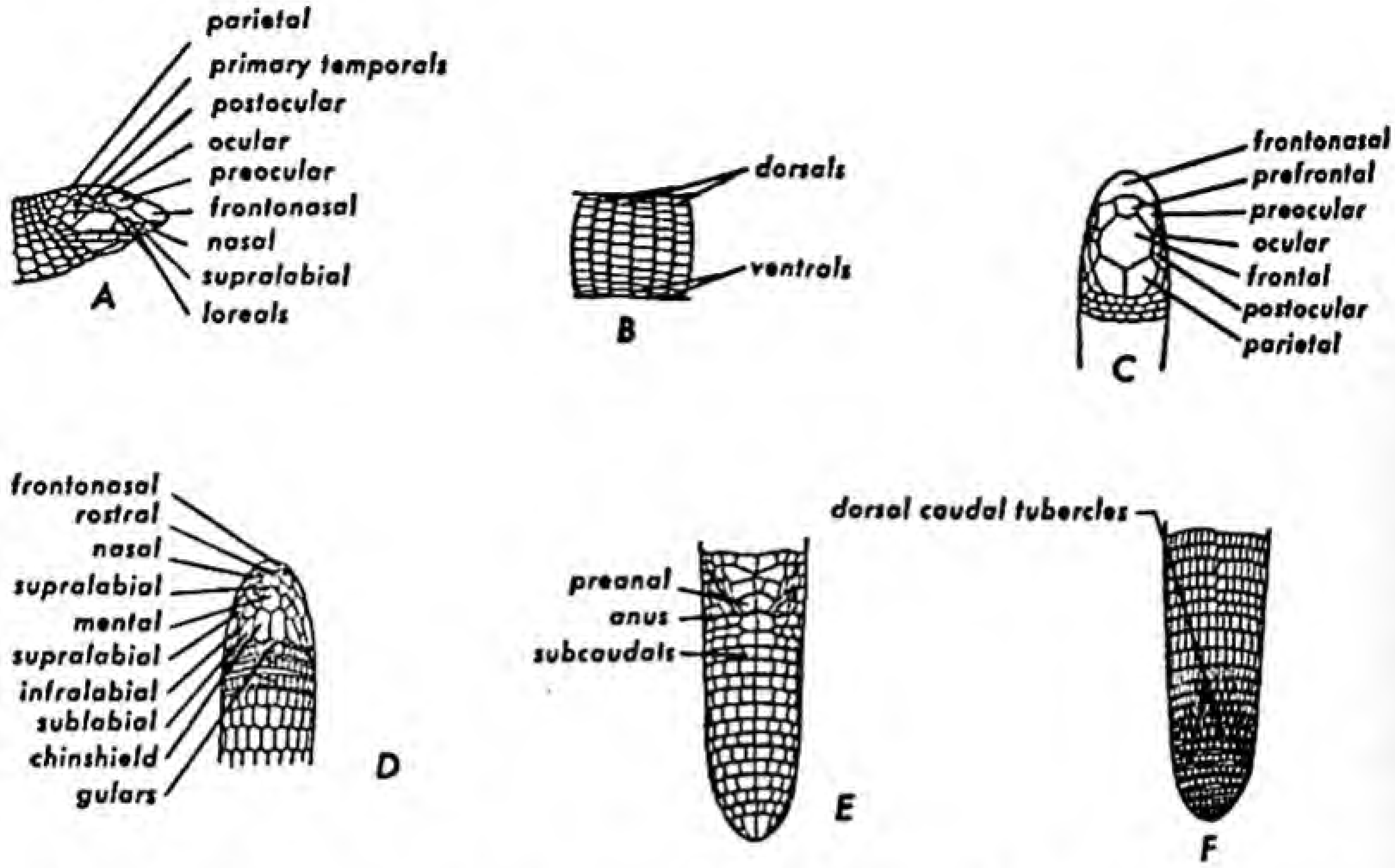


FIG. 130. Typical scutellation in *Rhineura,* from *R. floridana,* Florida. A, side of head; B, section of body in side view; C, top of head; D, underside of head; E, underside of tail and anal region; F, top of same. From Cope.

Florida Worm Lizard *Rhineura floridana* (Baird)

(Fig. 3, p. 60; Fig. 130; Pl. 122)

Range. Northeastern and central Florida. Type locality—Micanopy, Florida. (Map 34, p. 507.)

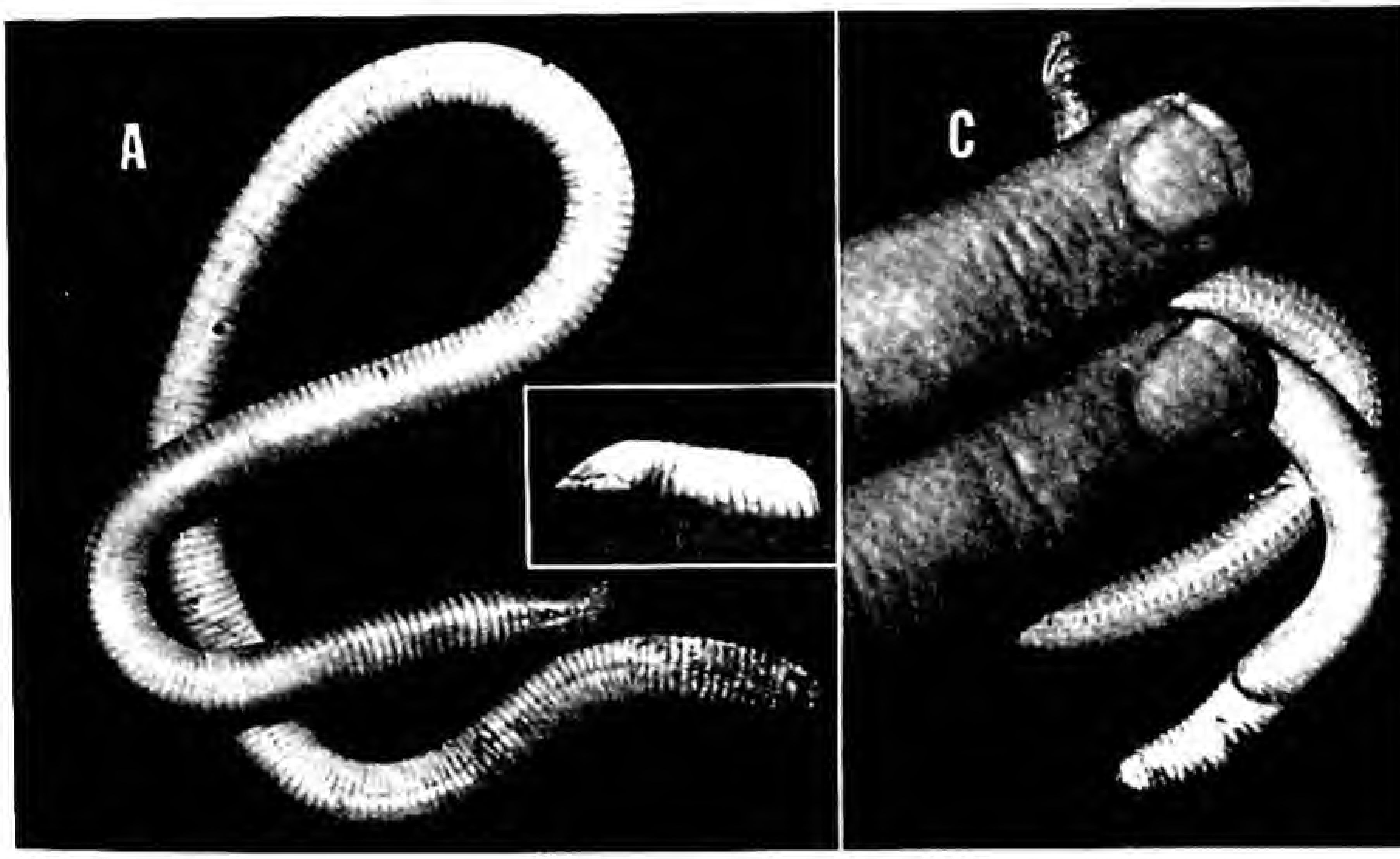
Size. Total length reaching a maximum at about 284 mm. (11 3/16 in.). The tail is from 1/16 to 1/20 of the total length. The diameter of the body is about 6 mm. (1/4 in.) in adults.

Color. Uniform yellow-brown to white in preservative; in life rose-colored.

Scalation. See Figs. 2, 3 and 130. Limbs, eyes, and ear openings absent; rostral completely hidden from view from above, situated on the ventral surface of the head, while the snout is formed by a large protruding scale; nasal plates also on ventral surface; about 250 rings of scales about the body; in each whorl 24 to 36 quadrangular, juxtaposed scales; a few scales on ventral surface behind head somewhat enlarged; ventral scales widest, dorsal scales narrowest. No pores in anal region; most of dorsal surface of tail flattened, covered with tubercular scales.

Recognition Characters. This is our only blind, earless, and limbless lizard. The difficulty in identifying them generally lies not in distinguishing these curious animals from lizards, but from earthworms, for they have an extraor-

dinary resemblance to them on account of the very similar annulation of the body. The presence of a head and tail, of course, easily distinguishes the lizard as a vertebrate and not a worm. Nevertheless even the best of collectors have been fooled—at least for a time—into identifying these rarities at a glance as just common earthworms. No doubt many are passed in just such a manner.



Pl. 122. *Rhineura floridana.* St. Petersburg, Florida. A, top view. B, side view of head and neck. C, underside.

Habitat. "Upland and mesophytic hammock; high pine; usually in dry soil" (Carr).

Habits. According to Carr, this species is

> completely fossorial; its behavior in penetrating and progressing in the soil is very similar to that of the earthworm, except that *Rhineura* leaves a tunnel in its wake. The calloused and dirt-covered dorsal surface of the tail is often used by captive specimens to close the mouth of the burrow, but individuals which I have uncovered beneath logs and leaf-mold have retreated tail-first down their tunnels. I recently deprived a mockingbird of a large specimen which it was attempting to eat, and twice have seen butcher-birds capture them.

Problems. The natural history, even such details as whether eggs are laid or the young born, is an open field for investigation and observation.

References. Carr, 1940, p. 77, habits, range (*Fla.*); Cope, 1900, pp. 686–688, fig. 141, description (*gen. lit.*).

Superfamily ANGUIOIDAE

All of our large groups—families—of lizards belong to completely different sections or superfamilies of the Saurians. For instance the iguanids and agamids comprise one section all to themselves, but only the iguanids occur in this country. Likewise the skinks (Scincidae) belong in a superfamily with several other families, but of that whole assemblage only the skinks occur in the United States. This is not so of the superfamily Anguioidea, which contains no less than three of the families that occur within the area treated here. These families are the Helodermidae, the Anguidae, and the Anniellidae. This grouping is mentioned here only to show the relationships of these extraordinarily diverse types which vary from arboreal to burrowing, from poisonous to harmless, from legged to legless, and from oviparous to ovoviviparous extremes.

The Lateral Fold Lizards

Family ANGUIDAE

The common name applied to this family describes the character, unique among North American lizards, segregating our representatives of the family Anguidae. But oddly the character is restricted to the two North American genera. All of the several other genera (some six) lack the lateral groove, and in fact look so much like skinks that at first thought one questions whether two such widely different groups can actually belong to one family. The groove extends from the neck to the hind limbs and is marked by granular scales widely different from the platelike dorsal and ventral scales. In lizards armored as are these, one can appreciate the necessity of a groove such as this to allow for the expansion that must occur when the eggs develop or meals are hearty. This observation provokes the interesting question of how the similarly armored skinks manage to get along without a lateral groove or other obvious means to allow for expansion. The lateral fold lizards are, then, in reality a subfamily group of the anguids. The characters on which the family as a whole is based are chiefly concerned with the structure of the skull, particularly of the arches and the roofing over the upper temporal fossa. The skin on the head is usually fused with the skull bones, at least middorsally. The scales on the body are, in practically all species, provided with separate bony plates (osteoderms) varying somewhat in shape and type of etching from genus to genus. The tongue can be protruded, and when retracted lies partially concealed in a fleshy sheath.

The teeth are pleurodont and constantly replaced. When new teeth grow in, they appear between the other teeth, not at the base of the old teeth as in iguanids.

Most members of the family are terrestrial, but some are arboreal. Some species of *Gerrhonotus* give birth to their young, others lay eggs. *Ophisaurus* and most other genera are egg layers.

The family is widely distributed, but has few members. It is represented in Central and South America as well as on this continent, in the West Indies, Europe, northern Africa, and east to Formosa. The lateral fold group (except for *Ophisaurus* which occurs in the Eastern Hemisphere) is restricted to North and Central America. Other genera, of the skinklike types, occur no nearer the United States than the West Indies and central Mexico.

KEY TO GENERA OF ANGUIDAE

1. Both forelegs and hind legs present .... *Gerrhonotus* (p. 438)
   No legs .... *Ophisaurus* (p. 466)

The Alligator Lizards

Genus *GERRHONOTUS* Wiegmann

This is a genus of many rather distinct groups, and a relatively small number of species. About forty-five forms are known, and these are distributed from Texas and British Columbia southward to Panama. These forms can be separated into six groups, only two of which are known in the United States. One of these groups (the *coeruleus* group) is almost entirely restricted to this country; the other (the *liocephalus* group) occurs only in southern Texas, where it is represented by a single form. One other group (the *imbricatus* group represented by *Gerrhonotus levicollis levicollis*) has been listed for this country, but I do not believe it actually occurs. Some features of the scalation of a typical member of the genus are shown in Fig. 131.

Some members of the genus lay eggs, and others are live-bearing. Even within groups there may be no constancy in this respect. All our representatives of the genus are terrestrial, but some species of Central America are arboreal. All are slow-moving, quiet, rather secretive lizards. Our species are rather dull-colored, but some in Mexico are bright green with orange eyelids. The dorsal pattern, when visible, consists of dorsal crossbands or blotches and irregular mottling; very feeble stripes may be present ventrally. Typically the sides are darker than the back. No distinctly striped species are known.

Fitch (1935, *gen. lit.*) summarizes the habits of the most common United States species, *coeruleus* and *multicarinatus:*

Recorded methods of self-protection used by alligator lizards include hiding in holes or among dry leaves, or exceptionally, in the water; climbing into trees or bushes; using the tail as a decoy and escaping when it breaks while the enemy's attention is distracted by its writhings; crouching motionless until the danger has passed; repelling the attacker by ejecting the offensive smelling or tasting excreta; holding the tail in the mouth encircling a branch so that the body cannot be swallowed or moved by the enemy; taking the offensive and driving away the enemy.

Animals which have been recorded as preying upon alligator lizards include snakes (racers, rattlesnakes, garter snakes), Skilton's skink (in captivity), shrike, red-tailed hawk, and domestic cat.

Insects of the larger and more slowly moving types comprise the bulk of the diet; beetles, caterpillars, and grasshoppers are those most frequently taken. Snails, scorpions, and spiders are also eaten. Stinging and biting animals are

preyed upon regularly, and although the sight of any small moving object stimulates the foraging lizard to attack, certain forms having offensive secretions seem to be habitually avoided. Small mammals and birds' eggs are occasionally eaten.

The breeding season apparently varies locally within each species, and the species differ in their time of mating when both occur in the same locality. During mating the head of the female is held diagonally across the temporal region in

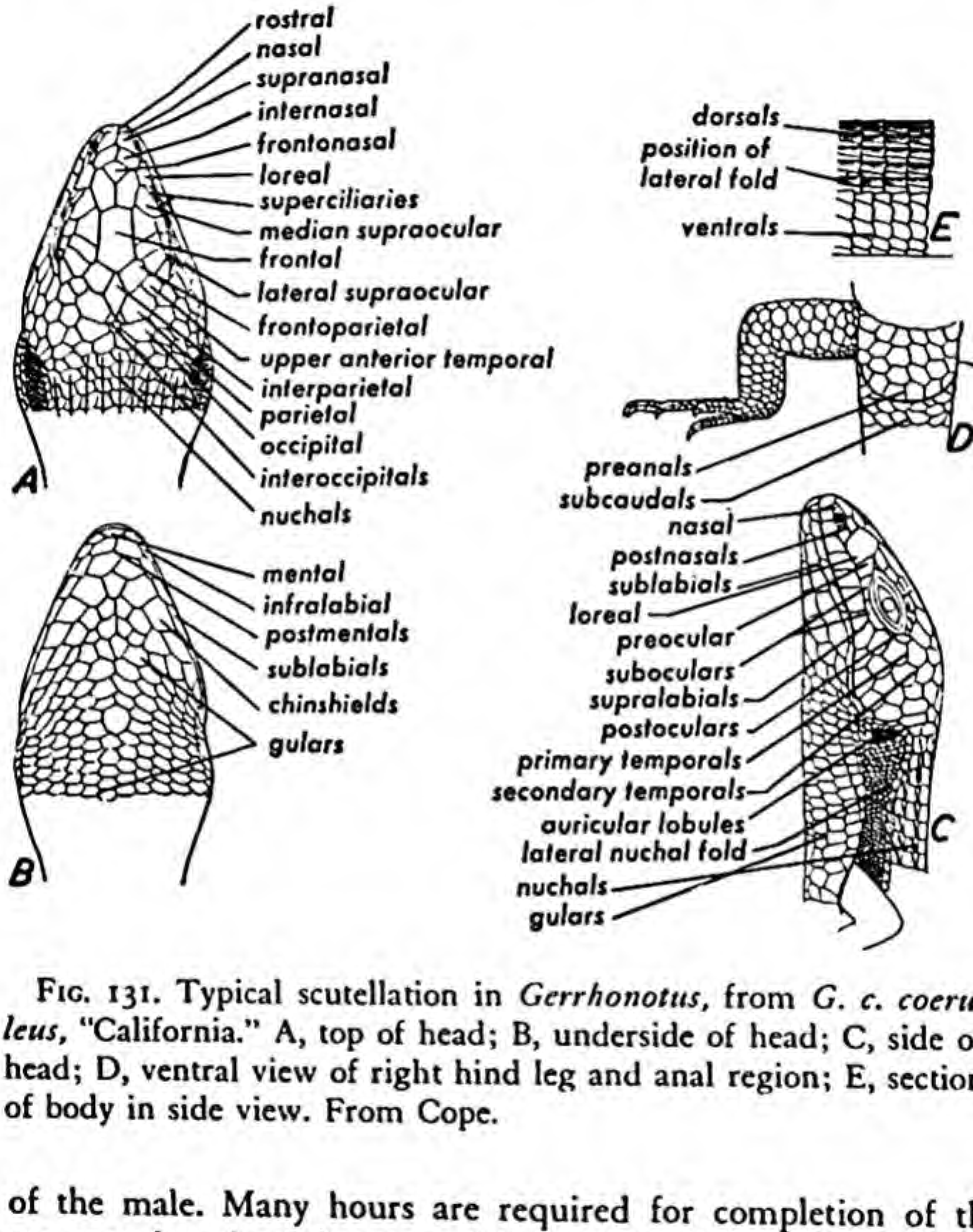


FIG. 131. Typical scutellation in *Gerrhonotus*, from *G. c. coeruleus*, "California." A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

the jaws of the male. Many hours are required for completion of the process. *Gerrhonotus coeruleus* is viviparous while *multi-carinatus* is ovoviviparous and deposits eggs which require several weeks to hatch. Viviparity in *coeruleus* may be correlated with its colder and damper habitat.

Several months of each year are passed in hibernation by the alligator lizards of some localities, whereas in other localities hibernation is incomplete; individuals may be active on warm days, even during the winter.

These lizards are solitary in habits and show almost no trace of social behavior. Fighting is unusual among them but may occur between individuals competing for the same morsel of food (as observed with those kept in captivity), or between breeding males competing for the same female.

Captive individuals showed indications of learning, and formed habits rapidly. *Gerrhonotus* probably ranks high among reptiles in intelligence.

Many of the characters used in the following key and the descriptions of scalation have been adopted directly from Fitch's summary. This has necessitated the use of the term "postnasal" in a different sense in these discussions than in the figures and in the descriptions of other genera. Fitch uses the term to include not only the two superimposed true postnasals, but also an anterior canthal and an anterior loreal, the former superimposed over the latter. His treatment of data is such that these scales cannot be separated; thus if the characters involving these scales are to be used at all they can be expressed only in Fitch's terms. The temporary adoption here of Fitch's meaning of the term "postnasal" is not to be construed as an acceptance of that meaning; further studies on variation should segregate the data individually for the three sets of scales involved.

KEY TO SPECIES OF *GERRHONOTUS*

1. A median scale bordering rostral posteriorly (Fig. 132A); nasal scale separated from rostral by a small lateral scale on each side; 7 scales between frontonasal, nasals, and rostral; back and sides not differently colored; belly dimly mottled . . . . *liocephalus infernalis* (p. 463)

   No median scale bordering rostral posteriorly (Fig. 131); nasal scale usually in contact with rostral, or sometimes separated by an internasal; 4 scales between frontonasal (or, if frontonasal absent, between the paired prefrontals), nasals, and rostral; back usually lighter than sides; belly seldom mottled, although usually with dim, longitudinal, dark lines 2

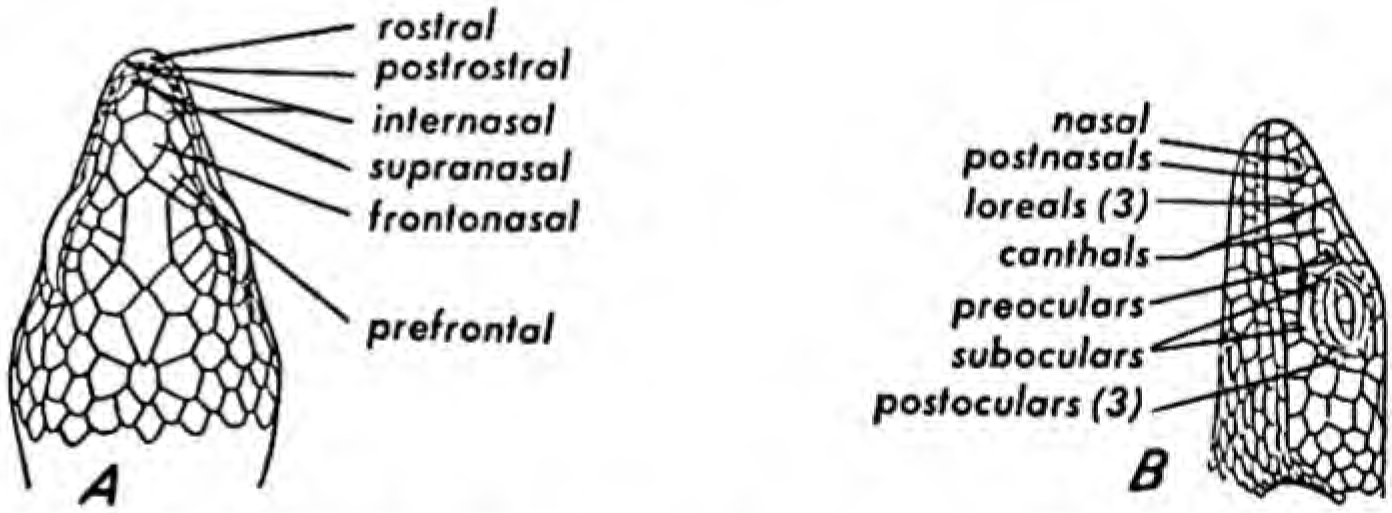


FIG. 132. *Gerrhonotus liocephalus infernalis.* A, top of head; B, side of head. From Cope.

2. Three pairs of scales between frontal and rostral (Fig. 133) . . . . *levicollis levicollis* (p. 464)

   More than 3 pairs of scales between frontal and rostral; almost always 1 unpaired median scale in front of a pair of prefrontals (Fig. 131A) 3

3. Dorsal scales practically smooth, the lateral 3 or 4 rows absolutely smooth, the median rows very obtusely keeled, if at all; dark bands across middle of back typically very broad, covering 2 or 3 scale rows . . . . *kingii* (p. 452)
   Dorsal scales strongly keeled, lateral scales at least feebly keeled; dark bands covering but 1 scale row on middle of back, if present 4
4. Dim, longitudinal, dark lines [1] on belly following edges of adjacent scale rows; tail, when complete, measuring less than twice the head-body length, and comprising usually less than 114 whorls of scales; iris of eye dark or pigmented in life; scale rows 14 or 16; interoccipital divided or not; frontonasal frequently enclosed laterally by internasals and paired prefrontals; postnasals frequently less

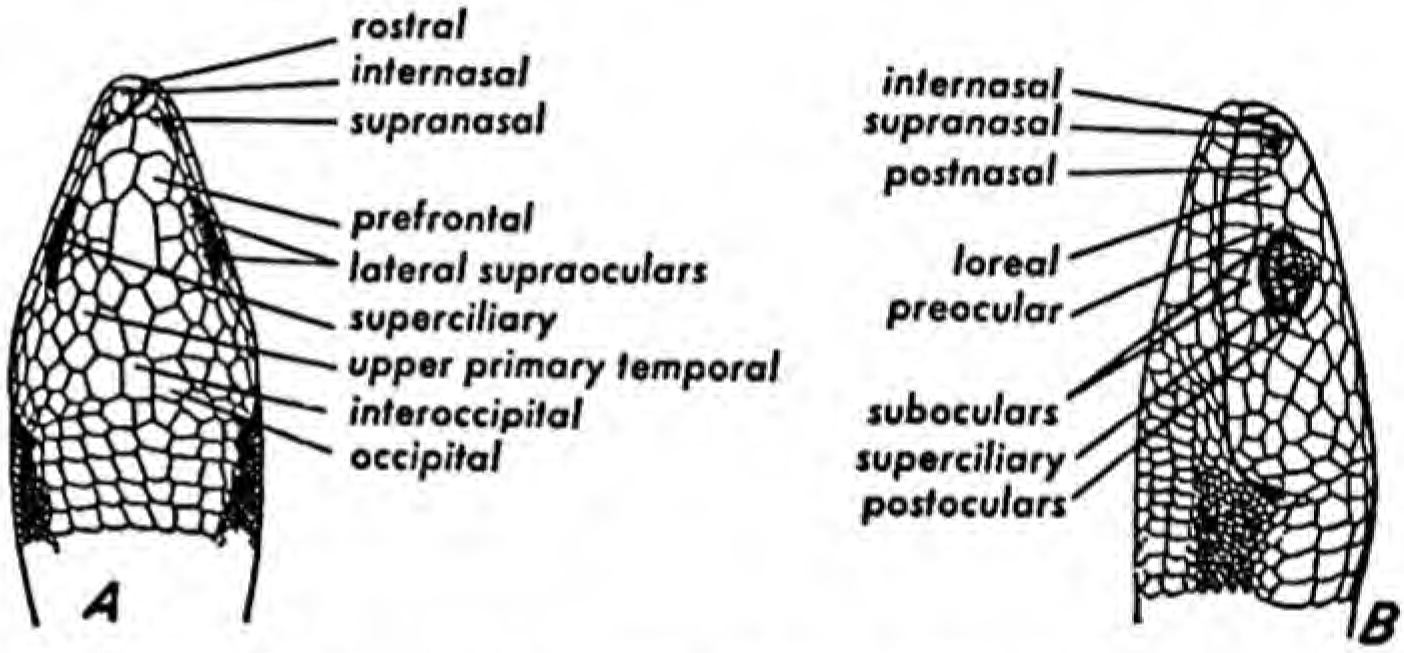


FIG. 133. *Gerrhonotus l. levicollis*. A, top of head; B, side of head. From Cope.

than 4 on each side; always more than 8 scale rows keeled near base of tail; snout-vent measurement not over 135 mm. 5
   Dark lines [2] on belly following middle of scale rows; tail, when complete, measuring more than twice the head-body length, and comprising usually more than 114 whorls of scales; iris of eye yellow and unpigmented in life; scale rows 14; interoccipital single; usually 4 postnasals on either side; frontonasal not enclosed laterally by internasals and paired prefrontals; frequently not over 8 scale rows keeled near base of tail; maximum snout-vent measurement 170 mm. 9
5. Fourteen full-sized longitudinal rows of dorsal scales 6
   Sixteen full-sized longitudinal rows of dorsal scales 7
6. Dark markings on back in the form of large median blotches or widened into bands; median neck scales square or longer than wide; rarely a total of 7 or 8 (usually 4 to 6) postnasals on the two sides; generally 16 scale rows, but the median scale rows often re-

[1-2] Great care must be used in determining the position of the dark lines. They are usually extremely dim. The overlapping edges of the scale rows sometimes appear darker and are confused with the pigmented lines referred to.

duced or absent in places; tail with usually more than 100 caudal whorls .... *coeruleus coeruleus* (p. 443)

Dark markings absent on back or in the form of small, scattered spots; median neck scales wider than long; usually 4 postnasals on each side; median scale rows not reduced; tail usually with fewer than 100 caudal whorls .... *coeruleous principis* (p. 448)

7. Postnasals rarely totaling 7 or 8 on the two sides; a middorsal series of spots on body and tail, but no continuous transverse bands .... *coeruleus coeruleus* (p. 443)

Postnasals usually totaling 7 or 8 on the two sides; tail with distinct, continuous, dorsal bands, and usually the body also 8

8. Temporal scales keeled; ground color of head and neck like that of body; head usually not spotted nor with a dark postocular stripe .... *coeruleus palmeri* (p. 446)

Temporal scales smooth;[3] ground color of head and neck often contrasting with that of body; head usually spotted, with a dark postocular stripe .... *coeruleus shastensis* (p. 450)

9. Upper rows of temporal scales strongly keeled, lower rows weakly keeled; keeled rows near base of tail exceeding or equaling number of smooth rows .... *multicarinatus webbii* (p. 460)

All temporal scales smooth, or upper rows weakly keeled; keeled rows near base of tail less than number of smooth rows 10

10. Transverse dorsal bands on neck often more than a single scale row in width, usually becoming reddish anteriorly; dark spots often present on head .... *multicarinatus multicarinatus* (p. 454)

Transverse dorsal blotches narrower, occupying no more than the width of a single scale row, not becoming reddish anteriorly; head not dark-spotted .... *multicarinatus scincicauda* (p. 457)

The Coeruleus Group

The group most characteristic of the United States is this one, which centers in this country. Of its eleven forms, eight occur in the United States and three only in Baja California and adjacent islands. Only one form (*kingii*) is recorded from mainland Mexico.

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[3] Also with smooth temporal scales, and otherwise running down to this point on other characters, is a subspecies, *Gerrhonotus coeruleus utahensis*, recently described by Dr. Angus M. Woodbury (A new *Gerrhonotus* lizard from Utah, *Proc. Biol. Soc. Wash.*, 58: 5–10, pls. 1–2). This race is the first of the Coeruleus Group, except *kingii*, recorded from the Rocky Mountains south of Montana. It is known from only a single specimen collected in Sink Valley, south of Alton, about 20 miles north of Kanab, Kane County, Utah. According to Woodbury, his "Utah Alligator Lizard" differs from *c. shastensis* "in great reduction of color pattern and in number of white-tipped scales; less contrast between general color of head and body; difference in distribution of dark color of abdomen; in contact of the two frontoparietals instead of contact of frontal and interparietal."

The chief characters of the group are the presence of enlarged supranasals which simulate the anterior pair of internasals (which are lacking), the contact of the nasal with the rostral, and the presence of a frontonasal scale. The combination occurs in no other group; this is one of the very distinct groups of the genus. The scalation of a typical member is shown in part in Fig. 131.

San Francisco Alligator Lizard *Gerrhonotus coeruleus coeruleus* Wiegmann

(Fig. 131, p. 439; Pl. 123)

Range. Coast of central California, in a "narrow strip of Transition Life Zone—from southern Sonoma County to Monterey" (Fitch). Type locality—San Francisco, California. (Map 36, p. 509.)

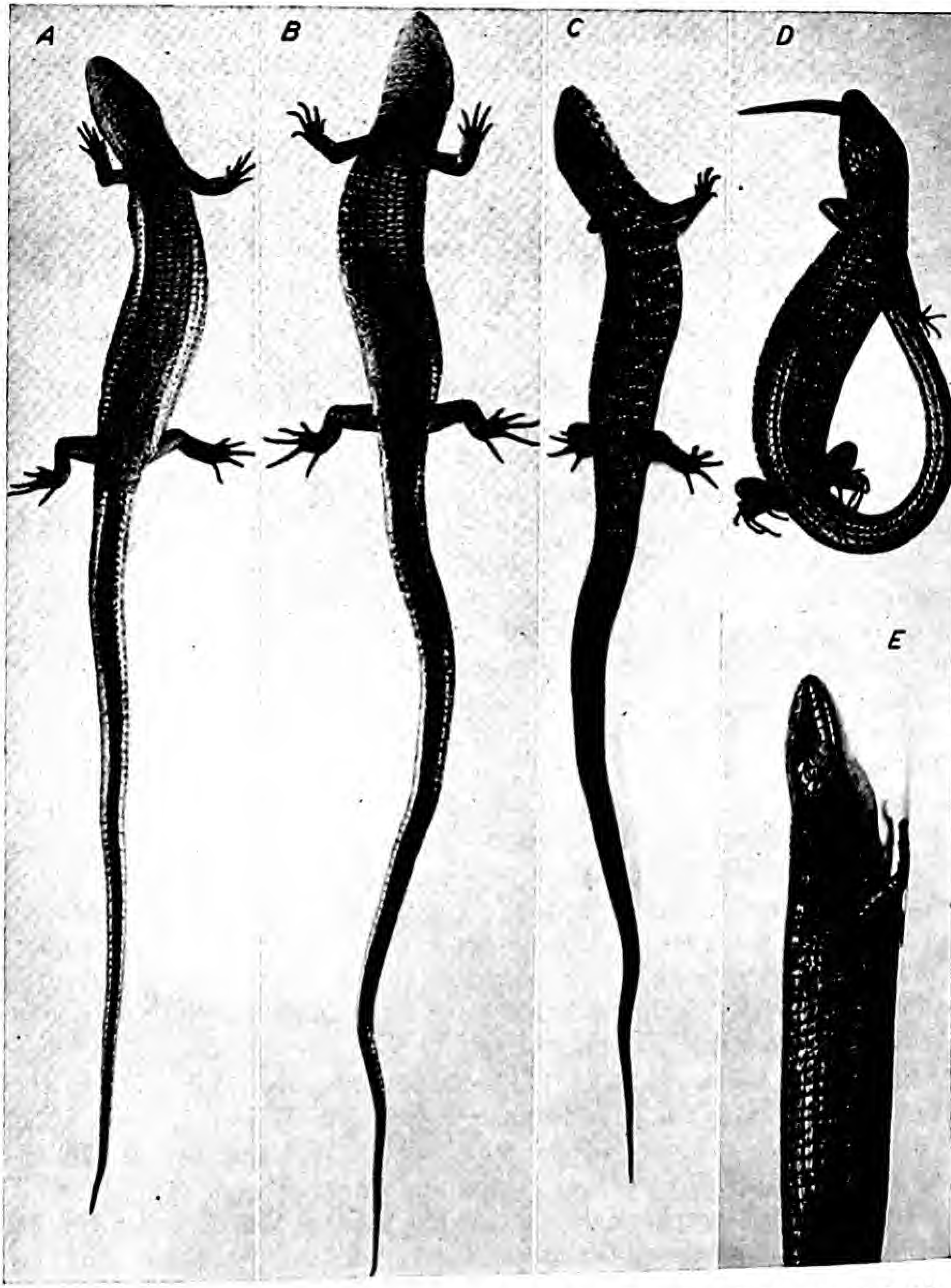
Size. Maximum snout-vent measurement about 108 mm. (4¼ in.); the tail is a little less than twice the head and body length.

Color. Top of head olive brown; ground color on back olive gray, occupying an area covering 6 full and 2 half scale rows. A median row of dark brown blotches, frequently expanded laterally to form crossbands about 13 in number. Sides dark brown, the color interrupted by narrow or broad vertical light areas; the dark spaces, if broad, are darkest along their posterior edges, which tend to be white-flecked. A dark postocular stripe, poorly defined or absent. Tail and limbs crossbarred. Lips sometimes barred; a dark line along the subocular in some specimens. Ventral surfaces whitish, immaculate or with dim dark lines extending along the edges of the scale rows.

Scalation. See Fig. 131. Dorsal scales from occiput to base of tail 43 to 54, average 47; longitudinal scale rows 14, 15, or 16, the lower numbers produced by a reduction in the median rows; scales in median rows 3 or 6 scale lengths behind occiput longer than wide; postnasals usually 4 to 6 (rarely 7 or 8); interoccipitals usually 2 or 3; tail whorls 94 to 116, average about 105. About 12 to 14 scale rows at base of tail keeled.

Recognition Characters. The only other alligator lizard occurring in the same territory as the San Francisco race is the red-backed form. In the latter the median neck scales are broader than long, the dark lines on belly follow the *middle* of the scale rows, the interoccipital is usually single, the tail whorls 116 to 134 (when complete), the scales on the arm less heavily keeled (or not at all), fewer scale rows at the base of tail keeled (8 to 10), fewer bands on the body, and larger size (up to 133 mm. [6¼ in.] snout to vent). A comparison with its nearest relative, the Shasta alligator lizard, which is the only one with which this intergrades, is given in the discussion of the latter.

Habitat. Fitch says the species "*coeruleus* is typical of a cooler and more humid habitat, usually in the vicinity of coniferous forests," comparing it with *multicarinatus,* which "is characteristically an inhabitant of the oak and chap-



Pl. 123. *Gerrhonotus coeruleus coeruleus.* A, B, C, San Francisco, California. D, E, Mirando, California.

arral belt in the foothills and valleys." Van Denburgh says specimens are very common "on the sand hills of San Francisco."

Habits. Van Denburgh states that

> females usually show little resentment when handled, but males often become very angry and will hiss and bite fiercely, although unable to draw blood. A captive male would hiss and jump at my fingers whenever the door of his cage was opened. The skin is renewed, sometimes at least twice a year, and, contrary to the method usual among lizards, is shed in a single piece, the animal escaping, as it were, through its own mouth and neatly inverting its former covering. The tail is strongly prehensile.

The food of adults consists of beetles, grasshoppers, etc., the relative importance of the various types in their diet depending to a large extent upon the abundance of the insects; the chief items of diet thus vary from time to time during the year. At times insects too large to be eaten entire, as male crickets, are killed and the appendages or other parts torn off and swallowed.

Young specimens exhibit interesting traits when first starting to eat. For a few days after birth they eat nothing, but then, in captivity, begin to snap at small flies. "When stalking flies, they crouched close to the ground and crept slowly forward, their heads swaying from side to side and their tails quivering or thrashing with excitement. Then, if the snap was successful, the prey was held firmly in the jaws while the lizard, with body and tail straightened, rolled rapidly over and over, grinding the fly in the sand" (Van Denburgh).

It is interesting to speculate whether or not this very curious habit of rapidly rotating on the long axis of the body, holding the limbs and tail straight back, may be an indication that the ancestors of these lizards lived upon larger prey; for it is a habit adapted to the tearing of small parts from a larger heavy body. It is a habit employed by crocodiles with horrifying effectiveness, causing the dismemberment of a body in short order. Skinks use the same habit when fighting; it is extraordinarily painful when the lizards grasp a piece of skin in their jaws and decide to twist it off. I am aware of this activity only in these lizards and crocodiles; it is not part of the behavior of iguanids, geckos, or others of the more common lizards.

Mating has been observed on April 11 and 12. Fitch (1935) records observations upon a pair in captivity.

> Occasionally the female struggled to escape and at such time the male employed his prehensile tail in holding her. Copulation began at about 4:30 P.M. The female's body was bent at right angles in the middle, the male's was looped over and under it so that the hemipenis employed was on the side opposite to that on which the male held the female's head. Brief periods of sexual excitement, during which the male made copulatory movements and tapped the sacral region of the female with his hind foot, alternated with longer quiescent periods. They separated at 9:15 P.M.

The young vary in number from 2 to 15 but are usually about 7. They appear in late August and during September. "The young are coiled up in a thin, transparent membrane when born. They almost immediately push the snout through this covering by straightening the body, and in the course of a few minutes set themselves entirely free" (Van Denburgh). Growth to maturity is completed in perhaps 3 years. When born the young measure from 25 to 30 mm. snout to vent, and by the end of the first winter measure about 38 to 50 mm. After a year they have reached a size of some 55 to 75 mm.

"Because of the relatively uniform climate in its range this lizard apparently does not hibernate completely. . . . During cold weather they apparently remain inactive and under cover but near the surface of the ground and ready to emerge whenever the air temperature becomes high enough for them to forage."

Among the enemies of the species are numbered the western skinks, which feed upon the young at times; hawks, including sparrow hawks, although these latter may be fought off without damage to the lizards, at least in captivity, if the lizard is large; snakes; and domestic cats. Automobiles kill numbers on highways.

"Nematode worms are sometimes abundant in the stomach and intestines. . . . Flukes have been found in their body cavities. Some individuals have colonies of orange-colored mites on the soft skin of the lateral fold; ticks are often found in or around the ear opening. There is no evidence that these parasites have any serious effect on the lizards" (Fitch, 1935).

References. Fitch, 1935, pp. 32–33, natural history; *idem,* 1938, pp. 413–418, complete systematic treatment; Van Denburgh, 1922, pp. 440–445, pl. 39, description, habits, localities; (all *gen. lit.*).

Sierra Alligator Lizard *Gerrhonotus coeruleus palmeri* Stejneger (Pl. 124)

Range. The Sierra Nevada of California from Plumas County south to northern Kern County, mainly on the western slopes in Hudsonian, Canadian, and Transition zones (5000 to 9000 feet). Type locality—South Fork of Kings River, Fresno County, California. (Map 36, p. 509.)

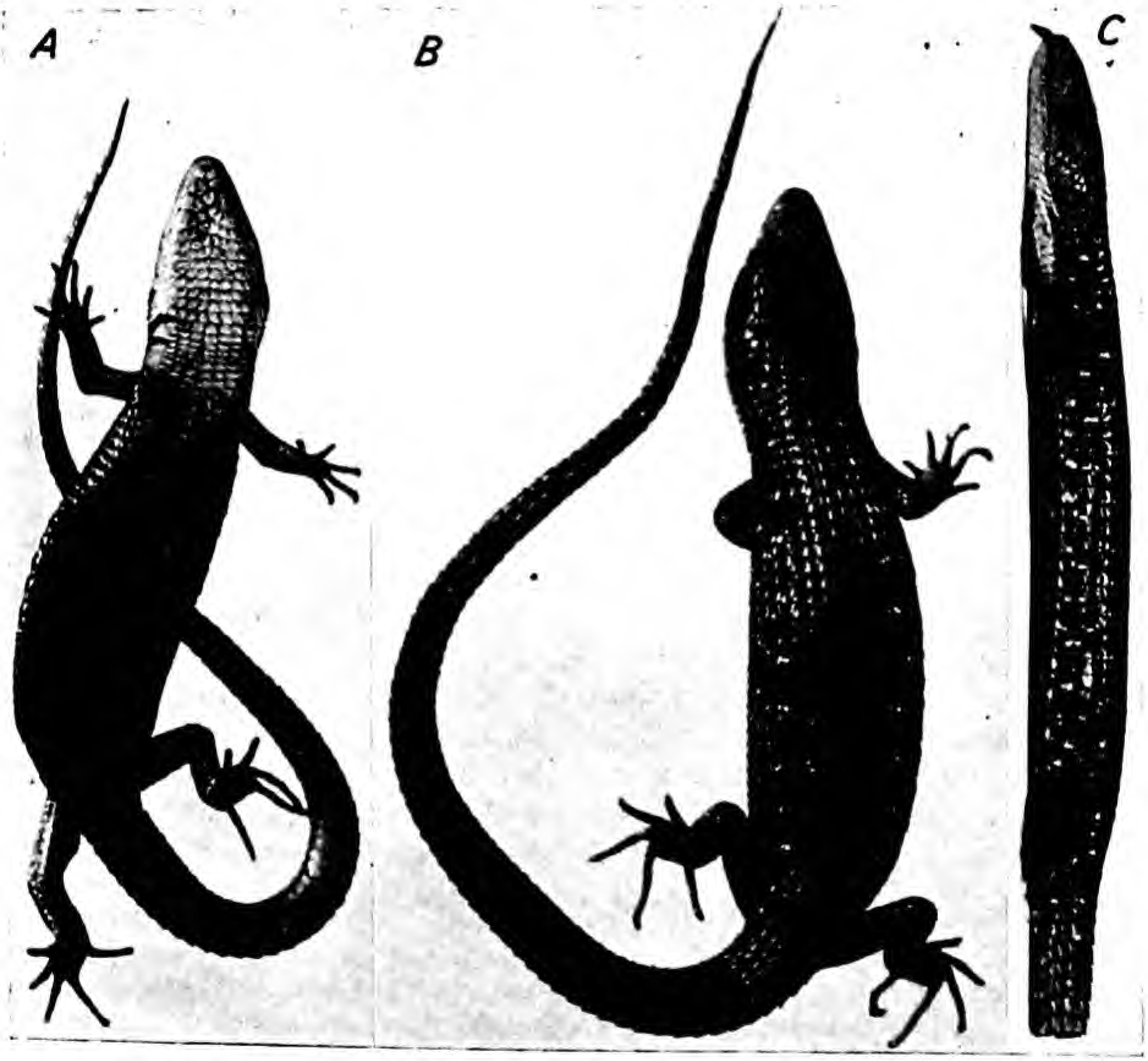
Size. Snout-vent length sometimes over 100 mm., reaching 120 mm. (4¾ in.). The tail, when complete, is over 1½ times as long as head and body.

Color. Van Denburgh describes the color of fresh specimens as follows:

The ground color above is olive-brown or bluish or greenish drab, usually a little paler laterally than near the middle of the back. There are no definite cross-bands, the dark pigments appearing in ill-defined marblings or blotches on the back, or in white-tipped black spots on the sides. The head and limbs are usually unicolor, but may be marked with darker brown. The lower surfaces are yellow-

ish or greenish white, sometimes slightly washed with gray. There are no definite longitudinal lines on the belly in the specimens which I have seen, but two specimens have indications of them between the rows of scales.

Scalation. Dorsal scales from occiput to base of tail 40 to 48, average 44; longitudinal scale rows 16, all of full size; all temporal and upper arm scales strongly keeled, as are most other scales on the body and limbs; postnasals 4



Pl. 124. *Gerrhonotus coeruleus palmeri*. Yosemite National Park, California. A, C, male; B, female.

on each side; interoccipital usually single; tail whorls 90 to 111, average about 100.

Recognition Characters. Within its range the red-backed and the San Diego alligator lizards are the only other species of the genus occurring. Comparisons are given in the discussions of each of these. To the north, the Sierra intergrades with the Shasta alligator lizard. The temporal scales are keeled in

the former, smooth in the latter; the first has all the upper arm scales keeled, and 3 or more rows on the forearm, but in *shastensis* usually not more than 3 rows of the upper arm and 2 on the forearm are keeled. "There are seldom distinct dark spots on the head or a distinct dark band behind the eye in *palmeri* but these are characteristic of *shastensis,* except in extreme individuals of the light phase" (Fitch, 1938).

Habits and Habitat. Fitch (1935) reports as follows:

> On June 23 and 24, I collected a series of this lizard in General Grant National Park, California. The weather was warm. Individuals were seen foraging in the middle of the morning and until late in the afternoon, but most of those found were under cover, usually beneath strips of yellow-pine bark which were lying on the ground or were loosely attached to dead trees and fallen logs. Other specimens were found on the bare rock beneath loose granite slabs. They were active and quick in their movements, often escaping even when uncovered in their hiding places. Perhaps because of the relatively scant cover, they seemed to run faster and for longer distances than do other forms of the species. The relatively larger feet of *palmeri* are probably correlated with its open habitat.
>
> In escaping, the lizards usually took advantage of the downhill slope. When an attempt was made to noose one seen crawling through a dense tangle of *Ceanothus velutinus,* the lizard, attracted by the shiny copper wire, climbed rapidly toward it, struck, and then dropped to the ground where it escaped by burrowing in the litter of dry leaves and sticks.

Fitch's records of the stomach contents of fourteen specimens indicates a wide choice of food amongst the arthropods, including ants, wasps, bees, beetles, spiders, etc. The bulk of the food was beetles.

Shedding specimens have been captured during June, July, and August.

Mating takes place rather late, in the first half of June. The broods appear to be small and late in appearance compared with other lower altitude forms.

Problems. The life history details are rather poorly known, yet should be of more than usual interest because of the problems the form faces in the short season and generally low temperatures.

References. Fitch, 1935, pp. 35–36, natural history; *idem,* 1938, pp. 418–420, complete systematic summary; Van Denburgh, 1922, pp. 445–447, description, localities; (all *gen. lit.*).

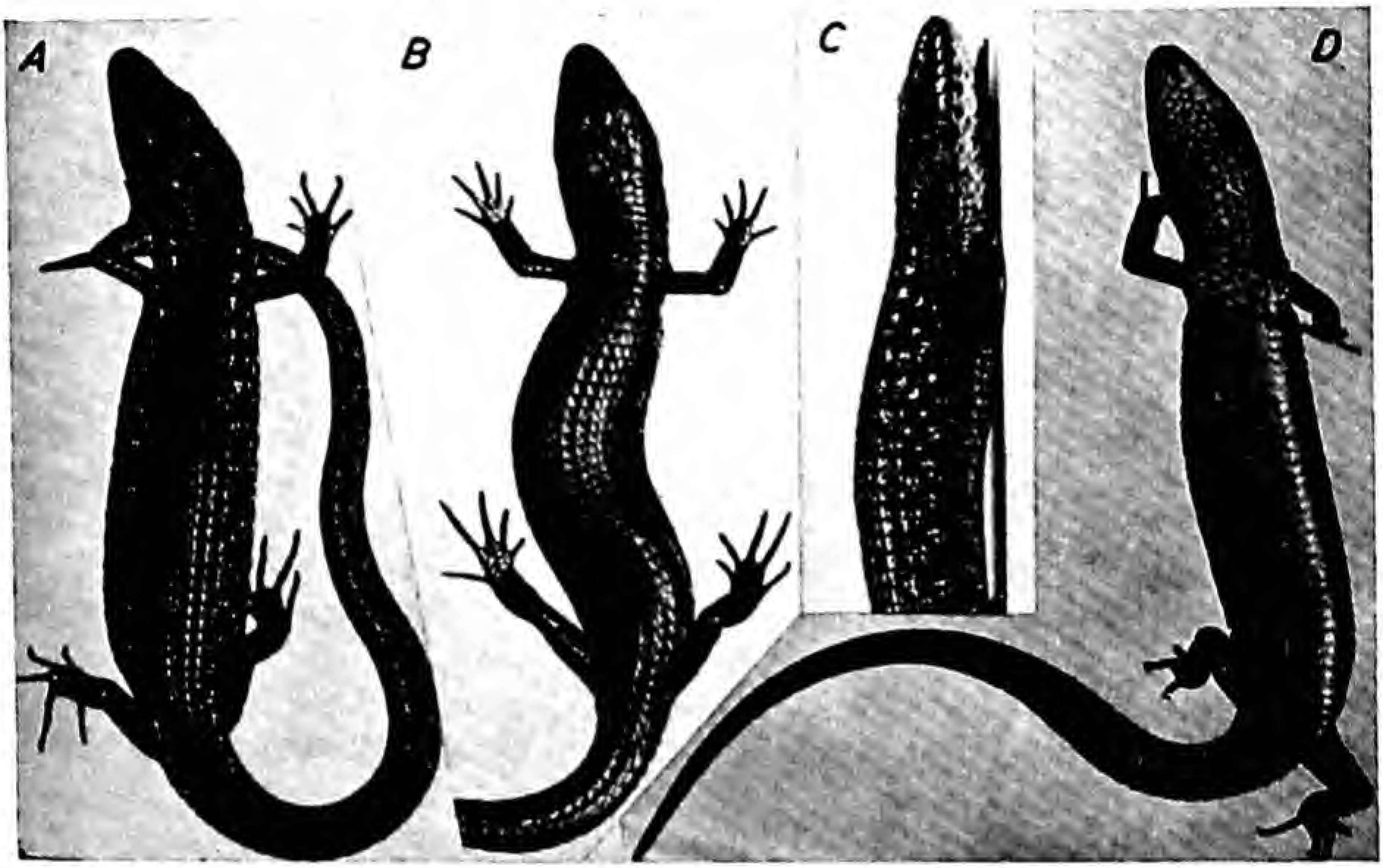
Northern Alligator Lizard *Gerrhonotus coeruleus principis* (Baird and Girard)

(Pl. 125)

Range. British Columbia east to western Montana, and south to western Washington and Oregon, and along the California coast to Humboldt County; Vancouver Island. Type locality—Oregon and Puget Sound. (Map 36, p. 509.)

Size. Maximum head-body length not over 100 mm. (4 in.); tail a little less than 1½ times the snout-vent length.

Color. A broad dorsal area olive gray to brown, covering 6 full and 2 half to 8 scale rows at middle of body. A middorsal series of small, dark brown spots, extending onto tail, not forming bands; sides of body irregularly marked with dark flecks, not forming very distinct vertical bars; scales on sides of body not white-tipped. Scattered dark spots on sides of tail. A dark



Pl. 125. *Gerrhonotus coeruleus principis.* A, California. B, D, Blewett Pass, Bellingham, Washington. C, Washington.

postocular stripe. Head markings reduced. Chin and sometimes chest cream; remainder of ventral surfaces bluish white, with usually some evidence of dim dark streaks along the edges of the scale rows.

Scalation. Dorsal scales in 14 full-sized longitudinal rows, sometimes with smaller lateral rows; dorsals 44 to 51 from occiput to base of tail, average 47 or 48; whorls on tail 86 to 100, average 93. Scales on upper foreleg mostly smooth; median neck scales broader than long; about 12 scale rows keeled near base of tail. Usually 8 postnasals (4 on each side); frontonasal usually enclosed by posterior internasals and paired prefontals; usually 3 interoccipitals.

Recognition Characters. The best characters to distinguish this from adjacent and overlapping races are the 14 rows of full-sized dorsals and the dim dark streaks down the edges of the ventral scale rows. The Shasta alligator lizard borders and intergrades with it in southern Oregon and northern Cali-

fornia, but has 16 full-sized rows of dorsals. In Oregon and extreme southern Washington part of its range is shared with the Oregon alligator lizard; this race has dim dark lines extending along the *middle* of the scale rows, usually a single interoccipital plate, only 8 scale rows keeled near the base of the tail, and adults measuring over 100 mm. (4 in.) snout to vent (up to 141 mm., or 5 9/16 in.).

Habits and Habitat. According to Fitch (1935), "Apparently it is characteristic of the Northern Alligator Lizard to occur in concentrated colonies. Perhaps this habit is correlated with the lizard's relatively small size and with the abundance of shelter and insect food in the dense vegetation of its habitat, and this most favorable type of habitat is interrupted." Fitch (1935) records finding specimens "along the shore of . . . [Siltcoos Lake, Lane County, Oregon], at the edge of thick woods surrounding it. They were sunning themselves or crawling about through the bushes, logs and debris just above the high water line." Near Bandon, Coos County, Oregon, most of the specimens

found were under logs in an open glade in the forest. Port Orford cedar and Douglas fir were dominant, with a heavy undergrowth of blackberry and tall ferns, and, in the open, dry grass a foot or more in height. The temperature was high during the middle of the morning, when the lizards were collected, but they were apparently not feeding at this time of day. All but one were found under logs. Although they were not especially active or quick in their movements, most of those that were discovered escaped into thick cover. When the tail of one was broken as the animal was captured, the disconnected member performed such lively movments that for a moment both observers who were present mistook it for a fluttering moth or butterfly. Most of the logs which offered suitable hiding places for the lizards were too large to be moved and consequently it is probable that only a small fraction of the lizards actually present were seen, yet in some places several were seen within a few square yards. The stomachs of seven specimens taken at this locality contained 10 small beetles, 1 crane fly, 1 noctuid moth, and 1 snail (Fitch, 1935).

A mating, typical for the group, was observed on April 6. The eggs number 3 to 5 in specimens recorded.

References. Fitch, 1935, pp. 23–24, habits; *idem,* 1938, pp. 404–409, complete systematic summary; Van Denburgh, 1922, pp. 437–439, description, localities; (all *gen. lit.*).

Shasta Alligator Lizard *Gerrhonotus coeruleus shastensis* Fitch

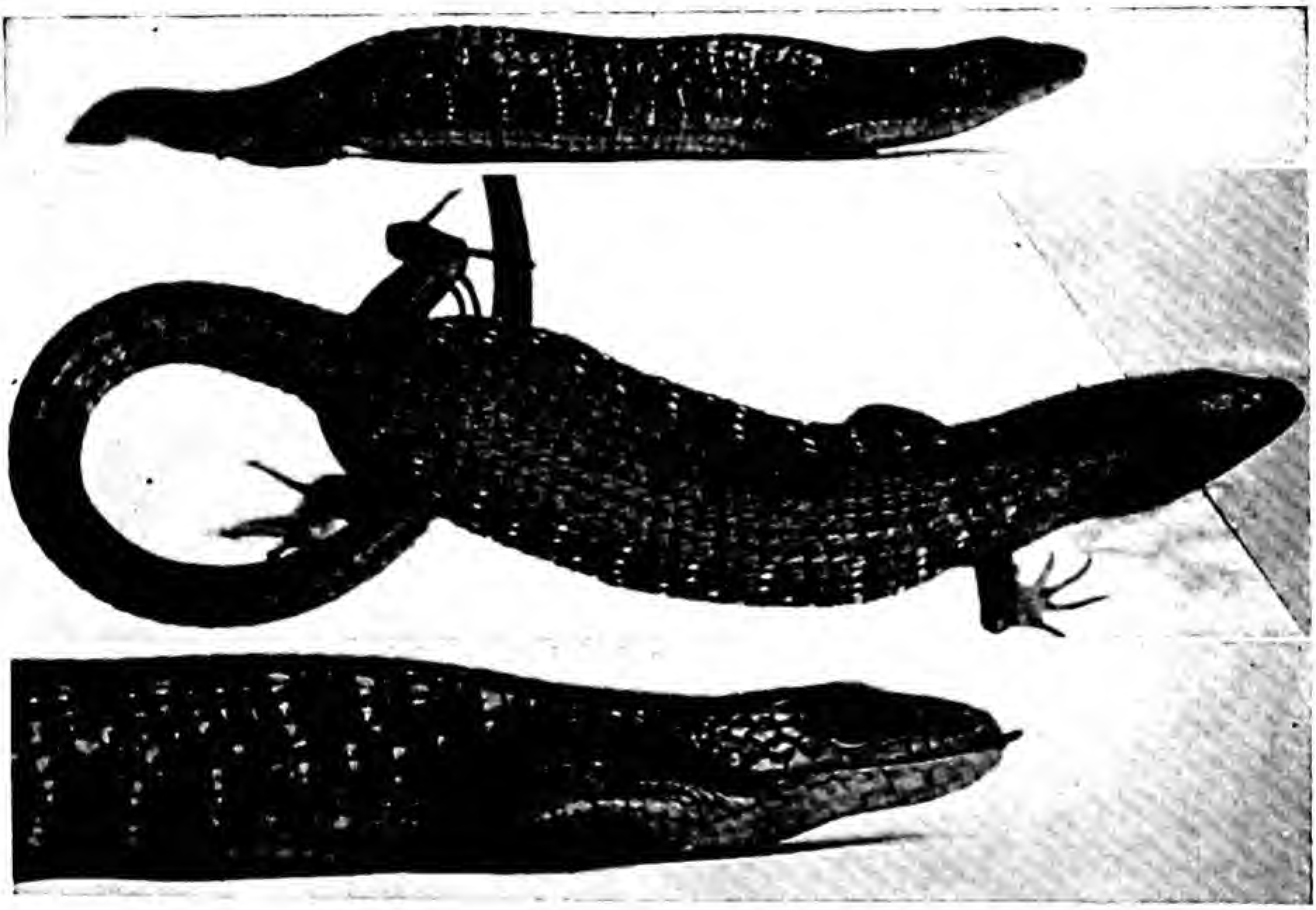
(Pl. 126)

Range. Mountains of extreme southern central Oregon, southward throughout northern California, except the extreme northwestern coast, as far as

northern Sonoma County and the Lassen Peak region. Type locality—2 miles southwest of Burney, 3000 feet above sea level, Shasta County, California. (Map 36, p. 509.)

Size. Relatively large; adults measuring from 90 mm. ($3\frac{1}{2}$ in.) to 133 mm. ($5\frac{1}{4}$ in.) from snout to vent. Tail about $1\frac{1}{2}$ times as long as head and body.

Color. A broad dorsal area brown, bluish, greenish, or yellowish. This color covering 6 full and 2 half scale rows on middle of body, 4 full and 2 half rows on neck; a series of dark streaks down the midline may be present; no very



Pl. 126. *Gerrhonotus coeruleus shastensis.* Northern California.

distinct crossbands dorsally, but usually a more or less scattered, dark pigmentation; sides of body with very irregular, dark, vertical bars; numerous scales on sides of body white-tipped, usually at least one in every transverse row. Dim bands usually present on tail. Head with numerous large dark spots; posterior edges of many head scales dark brown; a distinct dark postocular stripe. Chin cream; remainder of ventral surfaces bluish white; dim dark lines present on belly, extending along the edges of the scale rows.

Scalation. Dorsal scales in 16 full-sized, longitudinal rows, varying from 41 to 53, average about 48, from occiput to base of tail, all keeled. Tail whorls 93 to 115, averaging about 103. Frontonasal large, in contact with postnasals on both sides; interoccipital variable, divided or not; usually 8 postnasals.

Scales on foreleg smooth, or 1 or 2 rows of very weakly keeled scales on upper foreleg; temporal scales smooth; median scales on neck broader than long; about 12 rows of keeled scales near base of tail.

Recognition Characters. Within the area where it occurs, the Shasta alligator lizard may be known by its possession of 16 scale rows; all other forms in the same area have 14. In fact, its closest relatives, bordering and intergrading with it to the north and south, may also be distinguished by having 14 scale rows; this number is regular in the northern race but less so in the San Francisco race. From the latter, which more frequently has 16 scale rows, the Shasta alligator lizard may be distinguished by usually having 8, instead of 4 or 5 postnasals; and by having the azygous prefrontal usually in contact with the postnasals and loreal on both sides (usually separated from them in the San Francisco race).

Habitat. "It usually chooses for a habitat a well drained situation where there is abundance of decaying wood on the ground, preferably where bushes, trees, and open grassy places offer a variety of forage within a small area. Often it is abundant along creeks" (Fitch, 1935).

Habits. The habits of these lizards are as variable as their habitat. In some places they keep in the shade of bushes and are somewhat retiring. They may attempt, rather awkwardly, to climb trees in an effort to escape pursuit. In other places they seek open meadows, with scant shelter in the form of short grass and small, scattered boards and logs, in preference to seemingly more suitable open woods of yellow pine.

In the spring they do not emerge as early as *Sceloporus* and the skinks, yet they are found in colder zones than either of these.

The food consists of moth larvae, beetles, grasshoppers, and to a lesser extent other insects, spiders, millipedes, etc. Sometimes moth larvae, at other times beetles or grasshoppers, constitute the main portion of the diet.

The broods vary from 2 to 10, and are born during the first half of September.

A rather full account of the natural history of these lizards, from which these brief notes were taken, is given by Fitch (1935).

References. Fitch, 1935, pp. 24–32, natural history; *idem,* 1938, pp. 409–413, complete systematic summary; (both *gen. lit.*).

Sonoran Alligator Lizard *Gerrhonotus kingii* (Gray)

(Pl. 127)

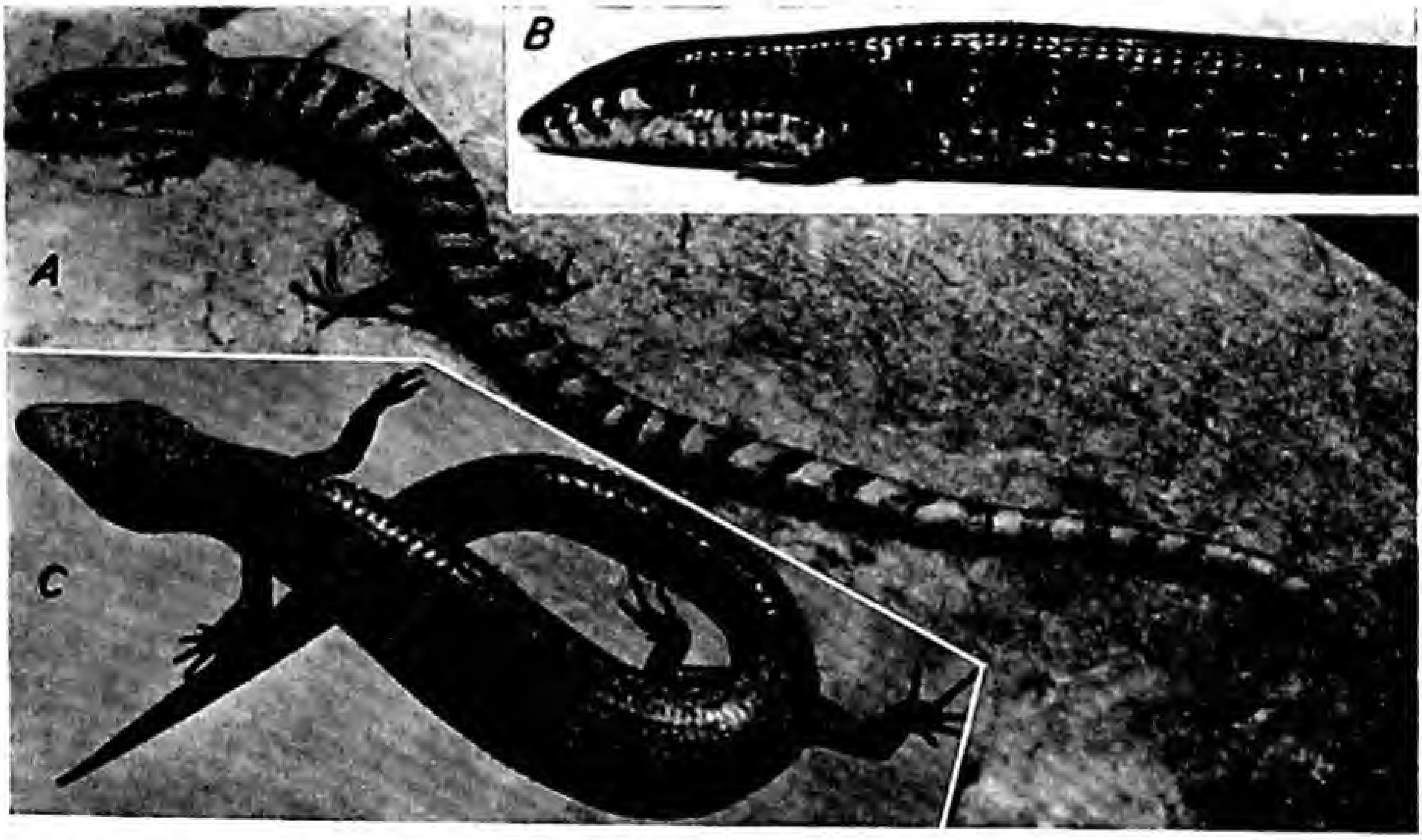
Range. Mountains of central and southeastern Arizona and of southwestern New Mexico, southward through western Chihuahua and eastern Sonora in Mexico. Type locality—"Mexico." (Map 36, p. 509.)

Size. Maximum snout-vent measurement about 100 mm. (4 in.); the tail is

about twice the length of the body. The body is slender, the head narrow and flattened, the limbs short and separated from each other by about 12 scale rows when adpressed to the sides of the body.

Color. Van Denburgh has described the color of fresh specimens as follows:

The ground color above, in adults, is ashy, drab, light brown, or grayish olive, paler on the sides, and crossed on the neck and body by about 9 to 12 continuous, broad bands of darker brown of varying shade. These bands usually are of about the width of three transverse rows of scales, are more or less undulate, and usually have blackish borders, at least behind. These posterior black borders of the brown bands become more intense laterally where the rest of the band is less evident or absent. The black scales often have white or whitish tips. The markings on the tail



Pl. 127. *Gerrhonotus kingii*. A, Pinos Altos, New Mexico. Gloyd photograph. B, C, Hamburg Mine Huachuca Mountains, Arizona; male.

are similar to those on the body. The limbs may be unicolor or marked with dark brown or black. The upper surface and sides of the head are grayish olive brown with few or many blackish brown spots. There are from three to five white spots along the upper jaw. The lower surfaces are yellowish white, more or less clouded with gray on the belly, and usually with numerous small black spots. These black spots or dots may be present only on the lateral ventral scales and the lower surface of the tail, or may be distributed over the entire lower surface. Their arrangement is rather irregular. They often have a tendency to form lines of dots but these may be either near the center of the rows of scales or near their edges. The lateral ventral scales often show transverse black bars with white spots, similar to those on the lateral dorsal scales.

Granular area of lateral fold dull gray.

Scalation. Dorsal scales in 14 to 16 longitudinal rows, usually 14; usually the scales of the median 6 or 8 rows are feebly keeled; 50 to 62 scales from interparietal to a point above the anus, average 55, usually over 52; scales on head, foreleg, and thigh smooth, some keeled scales on shank; 121 to 126 whorls of scales on complete tails.

Recognition Characters. The combination of 14 scale rows and over 52 dorsal scales usually will identify this species; there is some overlap with other species in these characters, however, so the nearly smooth scales over all the body, the slender body and short limbs, and the coloration must also be taken into account. Within its range, of course, no other species of alligator lizard occurs.

Habits and Habitat. A terrestrial, diurnal species. Specimens have been found walking about on the ground among stones, leaves, and in ruins of old buildings in the oak belt of the mountains of southern Arizona. Gloyd

found no individuals of this species below 6,000 ft. and six of the eight obtained were taken at 7,000 ft. or above. Five were found in open grassy areas, two were under boards, one was found dead at the base of a 300-foot cliff, another seen in Ash Cañon, Huachuca Mountains, escaped among the dead lower leaves of a group of sotol plants. These lizards moved with a deliberateness which gave an impression of much less speed than that actually attained and were difficult to capture alive.

Problems. Practically nothing has been described of the habits of this interesting, isolated species. Fitch suggests that two races may be involved, a northern and southern.

References. Fitch, 1938, pp. 402–404 (*gen. lit.*); Gloyd, 1937, p. 113, fig. 14 (*Ariz.*); Van Denburgh, 1922, pp. 461–464 (*gen. lit.*).

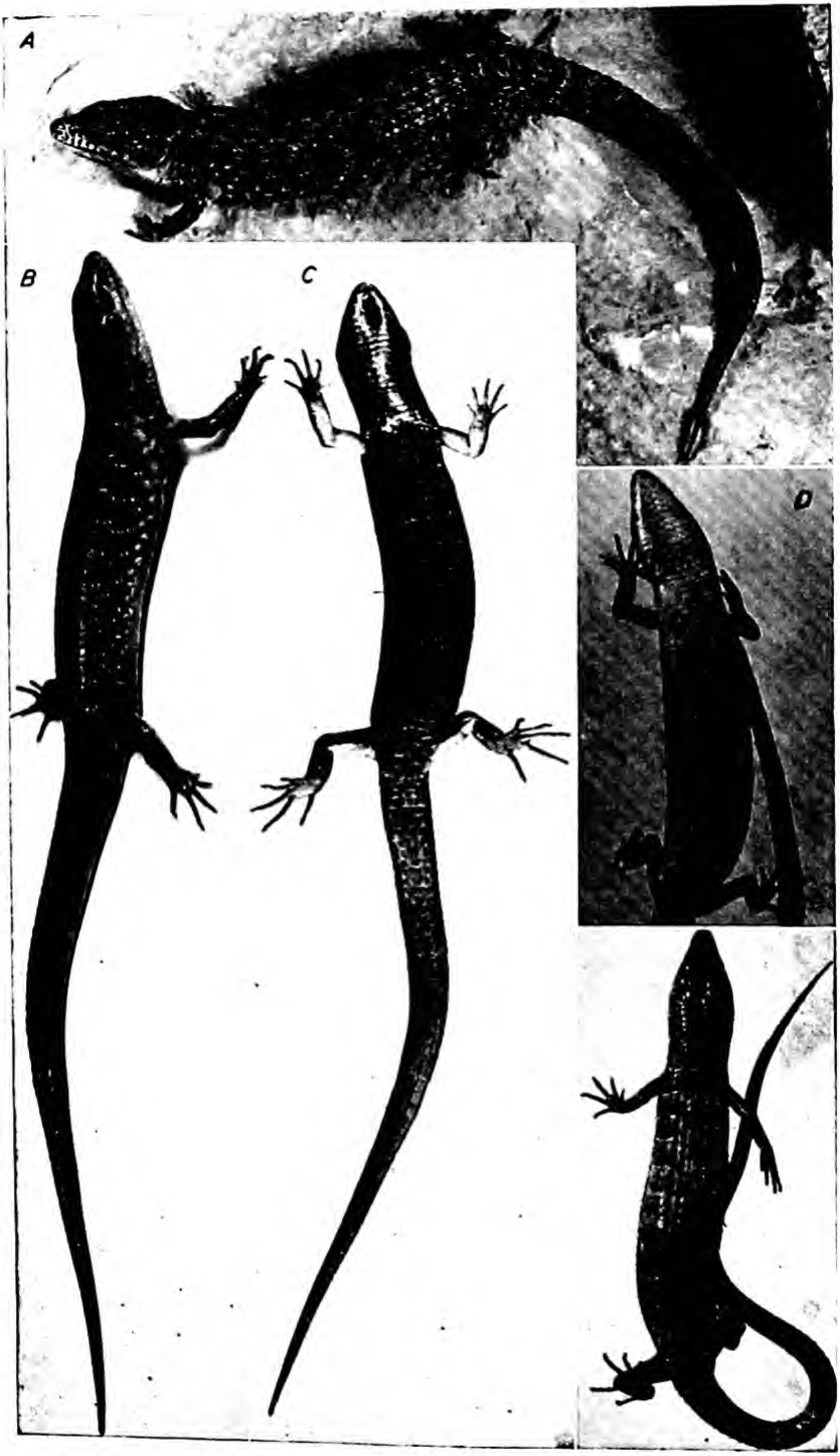
Red-backed Alligator Lizard *Gerrhonotus multicarinatus multicarinatus* (Blainville)

(Pl. 128)

Range. Central California, along the coast and Coast Range from Lake County south to Ventura County and on the islands off the Santa Barbara Channel; and the ranges bordering Sacramento Valley on the north, east, and west. Type locality—California. (Map 37, p. 510.)

Size. Maximum snout-vent measurement about 137 mm. (5⅜ in.); the tail is more than twice the head and body length, when complete.

Color. A dorsal area, about 6 full and 2 half scale rows wide, is a little lighter than the side, olive gray in color. The back is crossed by about 10 more or less irregular, transverse, dark brown bands not more than 1 scale row wide; on the sides these bands become black, and the tips of the scales



Pl. 128. *Gerrhonotus multicarinatus multicarinatus*. A, B, Plum Valley, Sierra County, California. U.S. Fish and Wildlife Service photograph. C, D, Yosemite National Park, California; female.

white; medially the brown bands are bordered on the anterior edge by a broad red band. The tail is similarly marked. The head may be almost uniform clay color, unspotted, or, more frequently, may have a few scattered dark markings; a dark postocular streak may be present. The ventral surfaces are practically immaculate, light slate gray, but faint darker lines can be seen extending lengthwise along the middle of the scale rows.

Scalation. Dorsal scales in 14 longitudinal rows, and numbering 44 to 52 (average about 45) from occiput to base of tail; usually 1 to 3 rows of weakly keeled scales on upper foreleg; median neck scales broader than long; 8 to 10 scale rows keeled at base of tail; tail whorls 116 to 134, when complete. Usually a single interoccipital; usually 4 postnasals on each side.

Recognition Characters. Within its range, the red-backed race is distinguished by the combination of 14 scale rows, entire interoccipital plate, 4 postnasals on each side, and the bold pattern with well-defined crossbands.

Habitat. According to Fitch (1935),

> in different parts of its range this form occupies a variety of habitats. It inhabits thickets of underbrush in groves of trees of the bottomlands along rivers in the Sacramento Valley, the digger pine and yellow pine belts in the northern Sierra foothills, oak forests, chaparral, and, in the coastal area, sand dunes and rocky, treeless hills. It occurs mainly in the Upper Sonoran Zone but is also found in both the Transition and the Lower Sonoran.

Habits. Although of sluggish demeanor at many times, these lizards can be surprisingly wary and quick of movement; however, the rapidity of action is not long sustained. Such peaks of activity are coincident with relatively high (90° F.) temperatures. When persistently pursued they take refuge in holes or under objects, or even in water. Sometimes they pretend to be dead, lying limply and motionless in the positions to which they are prodded; if the ruse proves unsuccessful and the lizards are picked up, they suddenly become highly active as they attempt escape by other means.

The biting reaction, an offensive gesture, is not always produced when the animals are cornered. If picked up this reaction is generally elicited, and it characterizes their reaction to attack by birds. Fitch describes how a large male retained an aggressive attitude when confronted by one and then several magpies, facing the bird on which its attention was centered with gaping jaws behind the protection of the tail, which was kept coiled in front of the lizard. For the lizard the advance position of the tail might be considered the counterpart of our "leading with the left." These tactics, broken by rushes at the birds causing their retreat, were continued, although three birds attacked it. The lizard could only watch one bird at a time, however, not demonstrating much ability to shift its attention rapidly. Eventually after repeated pecks the tail separated at the place where the birds concentrated their blows. The tail immediately gyrated actively, and the lizard scurried to cover unnoticed

by the birds, whose attention was held by the suddenly more active object confronting them. The tail was eventually overpowered and eaten.

The reaction to snakes (at least king snakes, racers, garter snakes, etc.) calls forth no such an offensive attitude, but one of abject fear.

> The lizards would crouch motionless until the body of the snake brushed against them. They would then rush frantically along the sides of the cage trying to escape through the screen, and would make no attempt to bite the snake or to drive it off as they had the birds. Half an hour after the snake was removed the lizards were restless and seemingly had not recovered from their fright (Fitch, 1935).

These varied reactions to danger verify the existence of very complicated behavior patterns and discernment in these lizards. Loss of the tail is not serious to the lizard, for it can be regenerated; but it does represent almost as great a loss of food for the lizard as it does again for the predator, for in it quantities of fats or other forms of stored food are accumulated to aid the lizard in living through adverse periods such as the winter months.

Mating occurs in early May and probably happens but once during the year. Copulation continues over a relatively long period (perhaps 12 hours); under some conditions it may continue for 26 hours or more. The mating animals are more or less oblivious to danger, and a high mortality may thus be expected among them during the mating season. Mating males are very much aware of possible competition, however, and will leave their activities to drive intruding males away.

Eggs number 6 to 17; they are probably laid in early July.

The food consists of insects and other arthropods. Beetles of offensive odor are avoided after a few attempts to eat them. In captivity a half-grown house mouse was killed and swallowed with ease. Fitch says the mouse seemed to have been swallowed by suction and the slightly peristaltic contractions of the neck muscles.

Toward the southern part of its range hibernation is probably incomplete, but farther north and at high altitudes it seems to last for several months.

References. Fitch, 1935, pp. 14–21, natural history, a highly interesting account; *idem,* 1938, pp. 390–395, complete systematic summary; Van Denburgh, 1922, pp. 450–455, pl. 40, description, localities (part); (all *gen. lit.*).

Oregon Alligator Lizard *Gerrhonotus multicarinatus scincicauda* (Skilton)

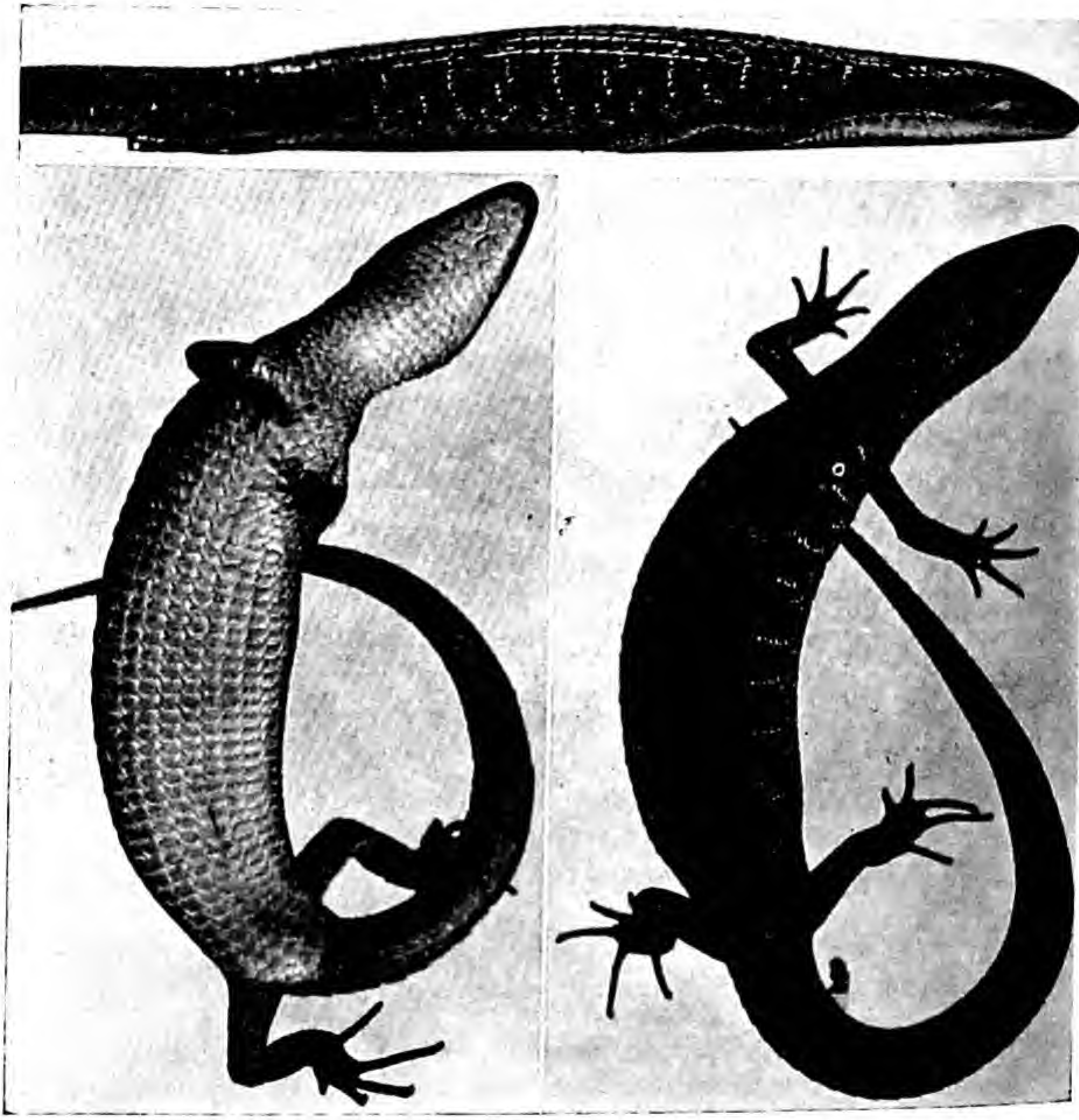
(Pl. 129)

Range. Southern central Washington through central Oregon to northwestern California, in the interior valleys between the Coast Range and the

Cascades, and eastward along the Columbia River. Type locality—"Dalles of the Columbia." (Map 37, p. 510.)

Size. Maximum snout-vent measurement 141 mm. (5⁹⁄₁₆ in.); the tail is a little more than twice as long as the head and body.

Color. Body with about 10 well-defined, dark crossbands, black on sides



Pl. 129. *Gerrhonotus multicarinatus scincicauda.* Corvallis, Oregon.

and lighter medially, as in the red-backed race; tail similarly marked; head usually not spotted or mottled; spaces between dorsal dark bands olive gray, not reddish; dim, darker lines extending along the middle of the longitudinal belly scale rows.

Scalation. Dorsal scales in 14 longitudinal rows; 45 to 52 dorsals from occipital to base of tail (average 48); 115 to 123 (average 118) tail whorls; 8 scale

rows keeled near base of tail; 1 interoccipital; 4 postnasals on either side; scales of upper foreleg smooth; upper rows of temporals frequently weakly keeled.

Recognition Characters. The Shasta and northern alligator lizards overlap the range of the Oregon race, but can be distinguished by having 16 scale rows or by having incomplete tail rings represented only by dorsal spots widely separated from lateral spots.

Habitat. According to Fitch (1935), "This subspecies is a characteristic inhabitant of the Garry oak belt. It is sometimes found in the Transition Life Zone, where yellow pine, black oak and madrone are the dominant plants, but I have never found it in thick coniferous forests."

Habits. Fitch (1935) describes the habits as follows:

> The oak bushes among which it lives supply abundant food and shelter in the layers of dry, windblown leaves, often several inches in depth, which collect under them. Concealed beneath the leaves around the roots of the bushes are cracks and holes into which the lizard may escape. In times of danger it burrows rapidly into the carpet of leaves with undulatory movements of the body and tail. The short limbs play a minor part in this action. Once hidden, it silently works its way around to some hole or crack into which it escapes. When the lizard is cut off from this mode of retreat, it usually attempts to escape by circling to the opposite side of the bush, where it emerges from the dry leaves and cautiously climbs into the concealing foliage. At such times its slow gliding movements often escape the notice of the collector who continues to search for it on the ground.

The activity is not dispersed evenly throughout the day. On cool days they emerge early, in the middle of the morning, and retire early, before sunset, but on warm days they remain torpid until late afternoon and then may be active until it is completely dark, 9:00 P.M. or later.

Hibernation is complete, lasting through November until late March. During this period they remain well below the surface of the ground.

Mating occurs from the middle of May to the middle of June. The eggs, which may number as many as 13, are laid in deep burrows constructed by mammals, in early August or late July. The young hatch in September.

The food consists of small vertebrates, except amphibians, and arthropods. Beetles and grasshoppers predominate.

> In capturing its prey the lizard usually glides slowly toward it, pausing at intervals to make lateral peering movements with the head and neck, viewing the object from different angles. When within striking distance it extends both hind legs forward along the sides of the body, braces the hind feet against the ground and then catches the desired object with a sudden, forward spring which may cover several inches. If it happens to be climbing through a bush at the time the capture is made, it is saved from falling by wrapping its tail around a branch (Fitch, 1935).

For a more complete and very interesting account of habits see Fitch's 1935 paper.

Problems. The northern and eastern limits of the range are yet to be clearly defined.

References. Fitch, 1935, pp. 7–14, natural history; *idem,* 1938, pp. 389–390, systematic summary; (both *gen. lit.*).

San Diego Alligator Lizard *Gerrhonotus multicarinatus webbii* Baird (Pl. 130)

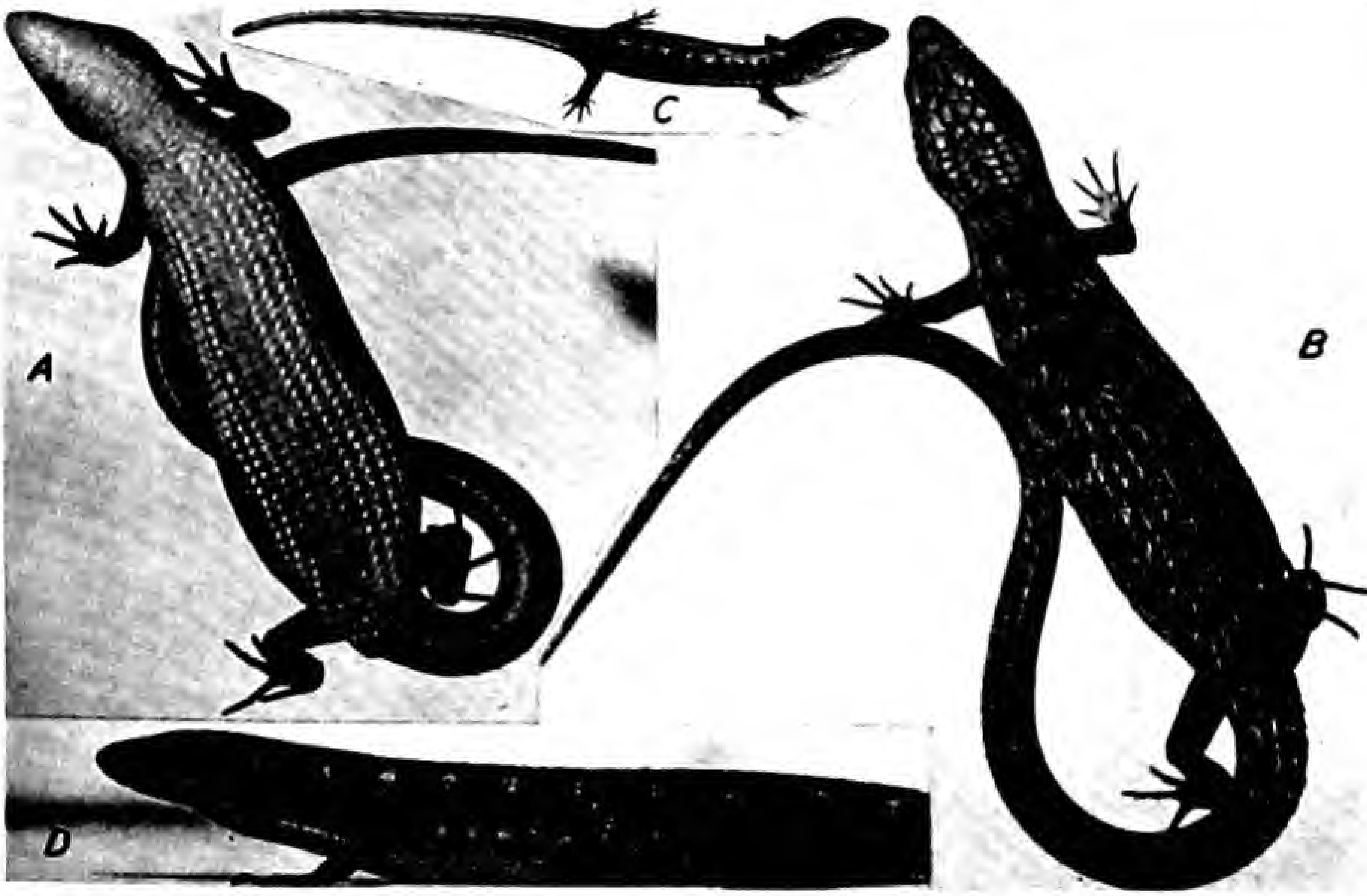
Range. West slopes of the Sierra Nevada, in the Sonoran life zone, from central California (Amador County) southward to the coast in Los Angeles County, and into northern Baja California along the coast and western escarpment. Type locality—in the vicinity of San Diego, California. (Map 37, p. 510.)

Size. A relatively large species, old adults usually reaching more than 130 mm. (5⅛ in.) snout to vent. The largest recorded is 170 mm. (6¾ in.). At hatching the young measure about 33 to 35 mm. (1¼ in.) snout to vent. The original tail is a little more than twice the length of the body when complete. Body relatively short, hind limbs moderate and about ⅓ snout-vent length; limbs overlap when adpressed.

Color. The ground color is olive, brown, or yellow, rarely with an orange suffusion (more frequently toward the southern part of the range); the sides may be slightly darker. There are 8 to 11 transverse black or dark brown bands on the body, each involving about 1 or parts of 2 scale rows, darkest on posterior edge; at a point about 5 scale rows above the lateral fold, the dark bands jog to the preceding scale row, and become less distinct and more irregular and undulating; an indentation on the middorsal line is usually prominent. The dark bands, on the sides of the body, are bordered posteriorly by white tips on the free edges of the lateral scales; in the middorsal area there are no, or poorly defined, white flecks. On the tail are somewhat similar dark bands, breaking up distally. The hind limbs are feebly barred. The head is gray, the edges of the scales darker; a dark temporal streak extending posteriorly from the eye usually is present. The ventral surfaces are clouded, with traces of longitudinal gray streaks along the middle of some scale rows. Iris yellow with no dark pigment in life.

Scalation. All the dorsal scales on body are keeled; usually 14 longitudinal scale rows at middle of body, seldom 12 or 16; dorsal scales 40 to 51 from interparietal to base of tail, average 46. Whorls of scales on original complete tails 116 to 146. Two upper rows of temporals distinctly keeled, 2 lower rows keeled or not; at least 3 rows of dorsal scales on upper foreleg keeled; 8 rows of scales on tail strongly keeled, *and* several other rows on each side weakly keeled.

Recognition Characters. In the southern part of its range, southward from Los Angeles County, the San Diego alligator lizard is the only species of its genus that occurs, and thus specimens from this area may be identified by locality alone. In the central part of its range, however, it occurs with the Sierra alligator lizard. There are numerous differences between these two, among the most prominent of which are the presence of 16 scale rows, fewer whorls of scales on tail, a tail less than twice as long as head and body, and a



Pl. 130. *Gerrhonotus multicarinatus webbii.* A, B, D, San Diego, California; male. C, Tujunga, Los Angeles County, California; very young. U.S. Fish and Wildlife Service photograph.

pigmented iris. In the San Diego subspecies there are usually but 14 scale rows, there are 116 or more tail whorls, the tail is more than twice the length of head and body, and the iris is uniformly yellow. Other differences in pattern proportion and scalation accompany these.

Habitat. Regions of scrub oak and low bushes, from sea level to 7500 feet, are frequented by these lizards. Occurring in areas of low rainfall (Upper Sonoran life zone), it nevertheless does not tolerate the severe drouths of the eastern slopes of the desert ranges of California.

Habits. Fitch (1935) summarizes the habits of this subspecies as follows:

It frequently climbs through vines and bushes in foraging. Grinnell and Grinnell tell of one which seized and made off with a cactus wren after the bird had been shot. Gander described the feeding of a captive individual, which ate fence lizards

and a mouse as well as insects which were offered, attempted to devour a pigeon egg placed in its cage and attacked a tree frog but was repulsed by the latter's offensive secretion.

The alimentary canal of one specimen which was examined contained only a trace of organic matter which could have been swallowed as food (beetle fragments and hair of a small mammal) but was crammed with a fine abrasive gravel. Numerous parasitic nematode worms were noted in the stomach and intestines. Possibly the lizard had eaten the gravel as a means of ridding itself of these worms.

Grinnell (1908: 168) records finding a specimen 10⅜ inches in length in the stomach of a 26 inch rattlesnake collected in Santa Ana Cañon, San Bernardino Mountains, on June 20, 1907.

Linsdale records a specimen dropped by a hawk when shot.

Mating occurs in May, and the eggs, 8 to 20 in number, are laid in June and in July. Shaw records a clutch found near San Diego, California, "about 4 to 6 inches below the ground surface in a burrow of the local gopher, *Thomomys bottae bottae*." The young hatch throughout September and in late July; the incubation period for one clutch of eggs was over 55 days (perhaps a total of 60). Seventeen freshly-hatched specimens measured from 79 mm. to 104 mm. (av. 84 mm.) in total length, and 26 to 35 mm. (av. 32.2 mm.) in snout-vent length.

Problems. The life history is poorly known and merits study. Fitch (1935) summarizes what little is known. It will also be of interest to learn by further exploration in intermediate territories exactly where the red-backed alligator lizard intergrades with the San Diego race. Very few specimens are known from Santa Barbara, Ventura, Amador, Calaveras, and Tuolumne counties.

References. Fitch, 1935, pp. 22–23, natural history (*gen. lit.*); *idem*, 1938, pp. 395–397, figs. 1, 2, maps, taxonomy (*gen. lit.*); Gander, 1931, pp. 14–15, food, feeding habits (*lit. cit.*); Linsdale, 1932, pp. 369–370 (*lit. cit.*); Shaw, 1943, p. 194, hatching of eggs, color of young (*lit. cit.*).

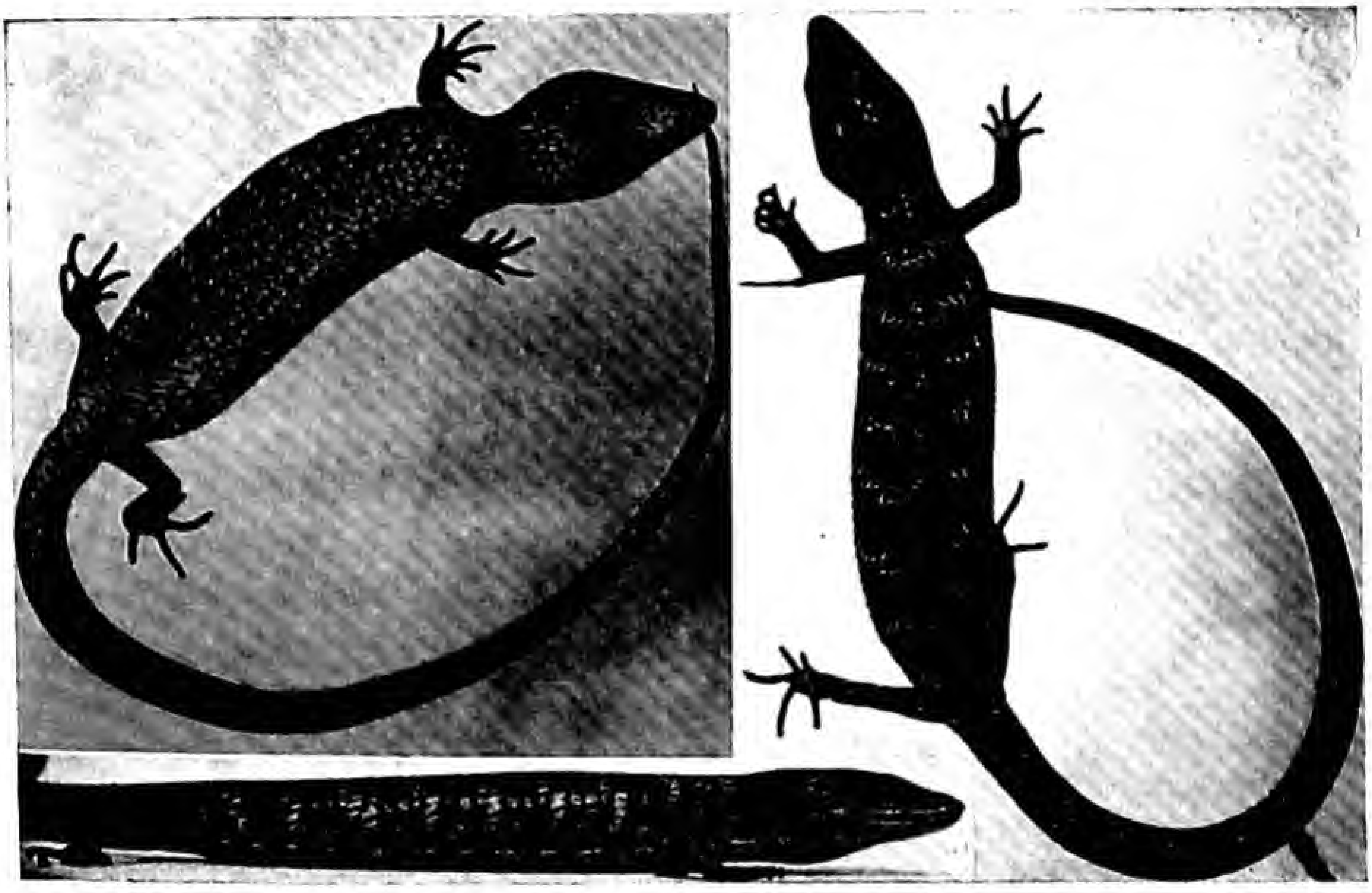
The Liocephalus Group

This is a small group of some three forms, centering on the Mexican plateaux north of the Isthmus of Tehuantepec. A single form barely enters the United States. The group is characterized by its very elongate head, body, and tail; the weak limbs (the weakest in the genus); the presence of a small, median, postrostral scale; 2 loreals following each other (and perhaps 1 or 2 superimposed); and long, low, posterior labials (Fig. 132). This is also a distinctive group.

Texan Alligator Lizard *Gerrhonotus liocephalus infernalis* Baird
(Fig. 11, p. 62; Fig. 132, p. 440; Pl. 131)

Range. Northern San Luis Potosí through most of Coahuila to central and western Texas. Type locality—Devil's River, Texas. (Map 38, p. 511.)

Size. The largest specimen examined measured 180 mm. (7⅛ in.) snout to vent. Strecker says this lizard reaches 200 mm. (8 in.). The tail is somewhat less than twice the head-body length. The limbs are rather feeble and slender; the hind legs measure about ⅓ the snout-vent length.



Pl. 131. *Gerrhonotus liocephalus infernalis.* San Marcos, Texas.

Color. Dull straw yellow to clay brown above and on sides, the head lighter; usually from 7 to 9 dim or fairly distinct, dark, irregular, wavy crossbands, extending across the back from fold to fold; each band is mixed or split with light flecks, which may form a nearly continuous band within the dark band. Base of tail similarly banded. Legs and head unmarked. Ventral surfaces gray or sometimes purplish, nearly uniform or mottled with white; gular region and tail not usually marked.

Scalation. See Fig. 132. Dorsal scales in 16 rows, the median 8 distinctly keeled, the adjacent row on either side very feebly keeled, others smooth; dorsals from occiput to base of tail 46 to 54. Generally 4, sometimes 3, scales between nasal and preocular; a small scale between nasal and rostral; a median scale bordering rostral posteriorly.

Recognition Characters. The form of the body is very distinctive and sharply differentiates this lizard species from any other of southern central United States. The combination of a deep, granular, lateral fold, the presence of 4 legs, and the small median scale bordering the rostral will positively separate the species from any other of this country. The median postrostral scale is distinctive as far as the United States species of the genus are concerned.

Habitat. On rocky hills among bushes is the ideal habitat for the species.

Habits. Little of importance has been published. The species is said to be highly pugnacious, but I have not found its close Mexican relatives so.

Problems. The natural history of this interesting species is not known.

Reference. Cope, 1900, pp. 517–519, fig. 91, description (*gen. lit.*), Strecker, 1930, pp. 9–10 (*Tex.*).

The Imbricatus Group

This group, consisting of some six forms occurring on the plateaux of Mexico and perhaps in southwestern United States, is placed in a separate genus, *Barisia,* by some authors. The basis for their action is the loss of the frontonasal, which is absent except in extremely rare cases. This character in itself will not define a genus (although the group is certainly homogeneous and perhaps should be recognized as a generic one), because a frontonasal *does* occur in its members, even though rarely, and because the same scale is absent in several other species of *Gerrhonotus* excluded from the *imbricatus* group.

Aside from the normal absence of the frontonasal in all species, the group is characterized by the markedly convex dorsal head scales, and the loss of at least the last superciliary scale (Fig. 133). In some forms only one superciliary scale remains. This group shows less relationship to either of the other two groups of this country than the other two do to each other.

Smooth-necked Alligator Lizard *Gerrhonotus levicollis levicollis* (Stejneger)

(Fig. 133, p. 441; Pl. 132)

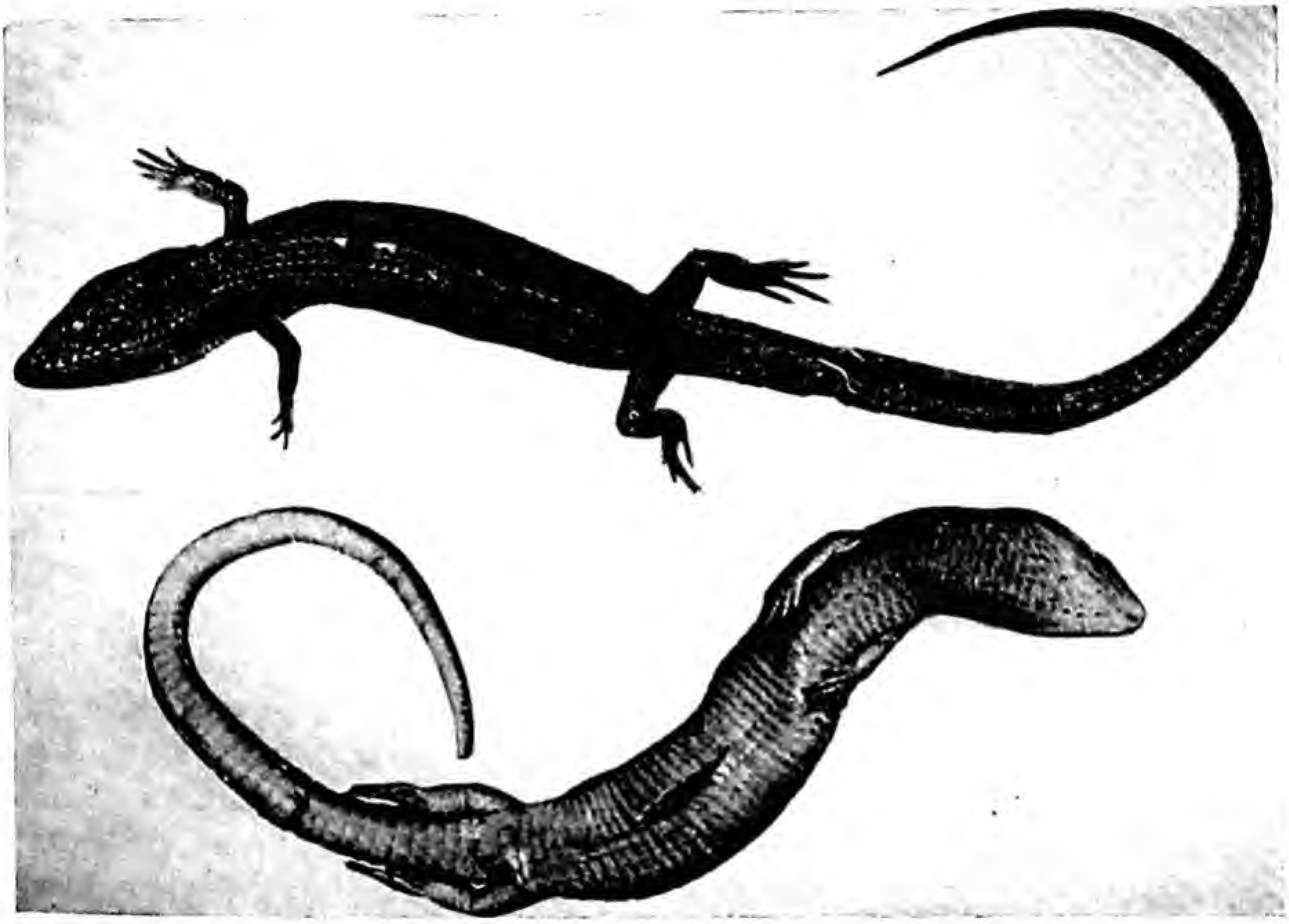
Range. Western and southern Chihuahua, and perhaps southwestern New Mexico or southeastern Arizona and adjacent areas in Sonora and Durango. Type locality—"Mexican Boundary." (Map 37, p. 510.)

Size. Snout-to-vent length reaches a maximum at about 120 mm. (4¾ in.). The tail, when complete, is a little more than 1½ times as long as the head and body. Body relatively short, compared with other United States *Gerrhonotus* species, and the limbs strong.

Color. Olive or slate above, becoming somewhat reddish brown or yellow-

brown on head; head almost always lighter than body; tail of same color as body except regenerated portions, which tend to be lighter and yellower; tips or edges of scattered dorsal scales with a white or bluish fleck. Ventral surfaces whitish, unmarked.

Scalation. See Fig. 133. Dorsal scales in 16 longitudinal rows, the median 6 keeled; transverse rows of dorsals, from occiput to base of tail, 47 to 50; ventrals in 12 longitudinal rows; scales on top of head convex; 3 pairs of scales,



Pl. 132. *Gerrhonotus levicollis levicollis*. Colonia Garcia, Chihuahua, Mexico. Maas photograph.

1 pair following the other, between rostral and frontal, but no median scale; loreal single, generally separated from prefrontal; only 1 superciliary; anterior supraocular broadly in contact with preocular; nasal separated from rostral.

Recognition Characters. All other species of the genus in the United States have one or more median, unpaired scales between the frontal and rostral, and all others except *l. infernalis* have the rostral in contact with the nasal.

Habitat. Unknown, but this lizard is undoubtedly a mountain or high-elevation species. I have collected specimens of a closely related Mexican subspecies (*l. ciliaris*) in oak woods among dead leaves.

Habits. Unknown.

Problems. Whether or not this species actually occurs within the United

States is a problem to be investigated by further collecting in the mountains of southern New Mexico and Arizona. After these many years of search in those and nearby areas it does not seem probable that the species actually occurs in this country, but a definite conclusion to that effect is not yet warranted. There *are* lizards that we know surely occur in those ranges but of which no specimens have yet found their way into the hands of a scientist: for example, the *Bipes*.

The natural history is completely unknown, although the species probably is not rare in western Chihuahua.

References. Cope, 1900, pp. 535–536, fig. 96, redescribed, illustrated (*gen. lit.*); Smith, 1942, pp. 364, 367, taxonomy (*lit. cit.*); Stejneger, 1890, pp. 184–185, description (*lit. cit.*).

The Glass-Snake Lizards

Genus *OPHISAURUS* Daudin

This genus contains about seven living species, but only one occurs in this hemisphere. The other species occur in Europe, southern Asia, and Borneo. Our species is restricted to the United States, so far as known.

One other genus of the family is like this in lacking useful limbs, and several others approach it in having limbs with only 1, 2, or 4 digits, or in having only tiny hind legs. This is the only genus with a lateral fold, however, that lacks or has vestigial limbs. Its relationship to *Gerrhonotus* is clear. Some species have vestiges of hind legs (*apus,* etc.), and all have internal evidences of the limb girdles. Some features in the scalation of the United States species, a typical member of the genus, are shown in Fig. 134.

Glass-Snake Lizard *Ophisaurus ventralis* (Linnaeus)

(Fig. 1, p. 60; Fig. 134; Pl. 133)

Range. Throughout southeastern United States northward to Cumberland and Buckingham counties, Virginia, Tennessee, and in the valley of the Mississippi to Wisconsin and the dune region of northern Illinois and Indiana; westward through the eastern two thirds of Kansas and Oklahoma, and to Long. 100° W. in Texas; not known in or south of the Brownsville region. Type locality—Carolina. (Map 39, p. 511.)

Size. These are elongate, slender lizards reaching a snout-vent length of about 250 mm. (9¾ in.). The tail is considerably longer, about 1⅗ to a little more than 2 times the body length. The over-all length of the largest specimen recorded is 952 mm. (37½ in.), but this is extraordinary; the usual total

length, if the tail is unbroken, does not much exceed 700 mm. (27⅝ in.). Legs are completely lacking externally.

Color. The dorsal ground color is light gray to brown; this color covers the head, the body in a broad median area involving 6 scale rows and the edge of the adjacent row on each side, and the tail in an area involving 4 scale rows. The ground color is rather sharply differentiated laterally from the dark sides.

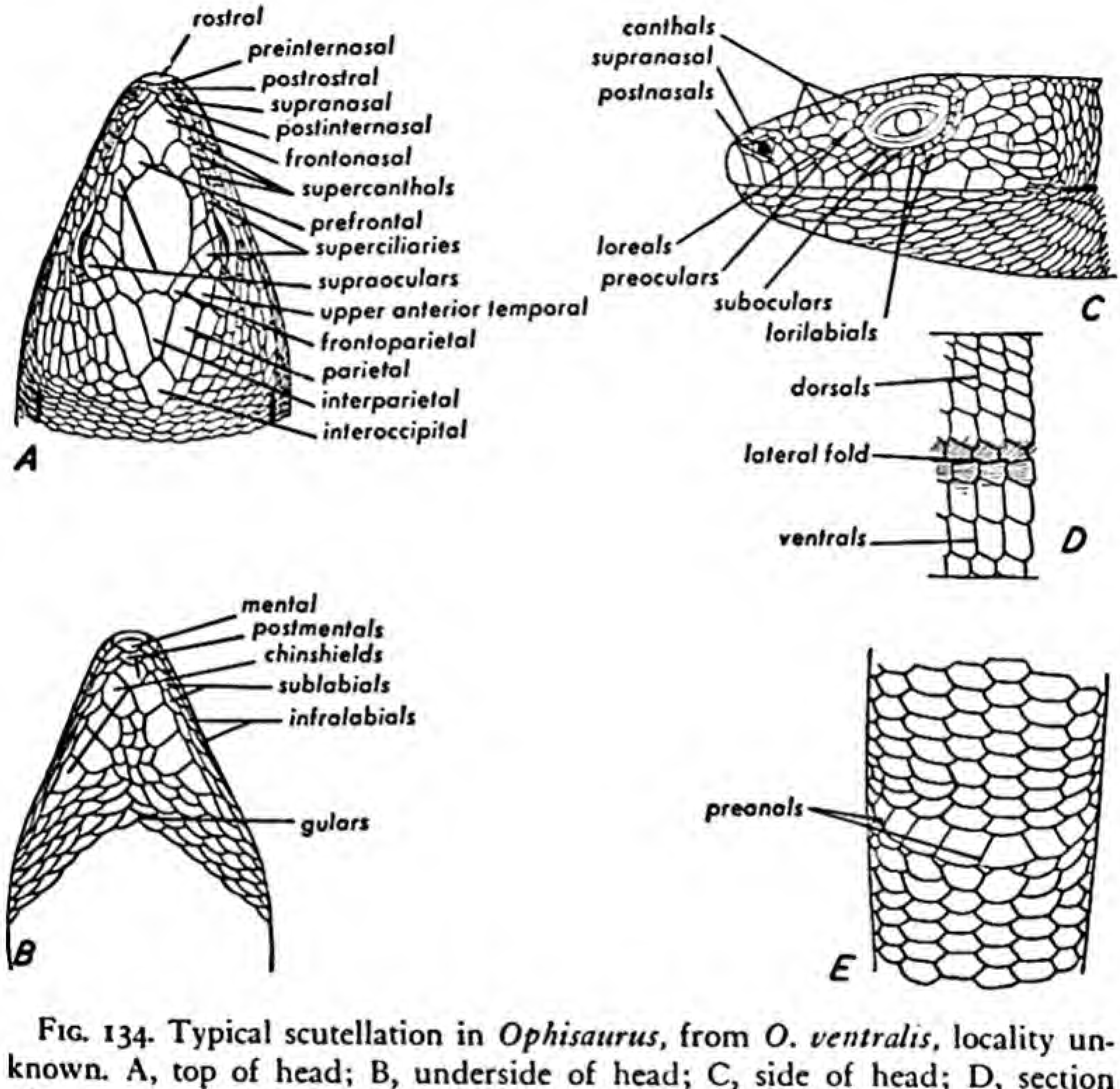


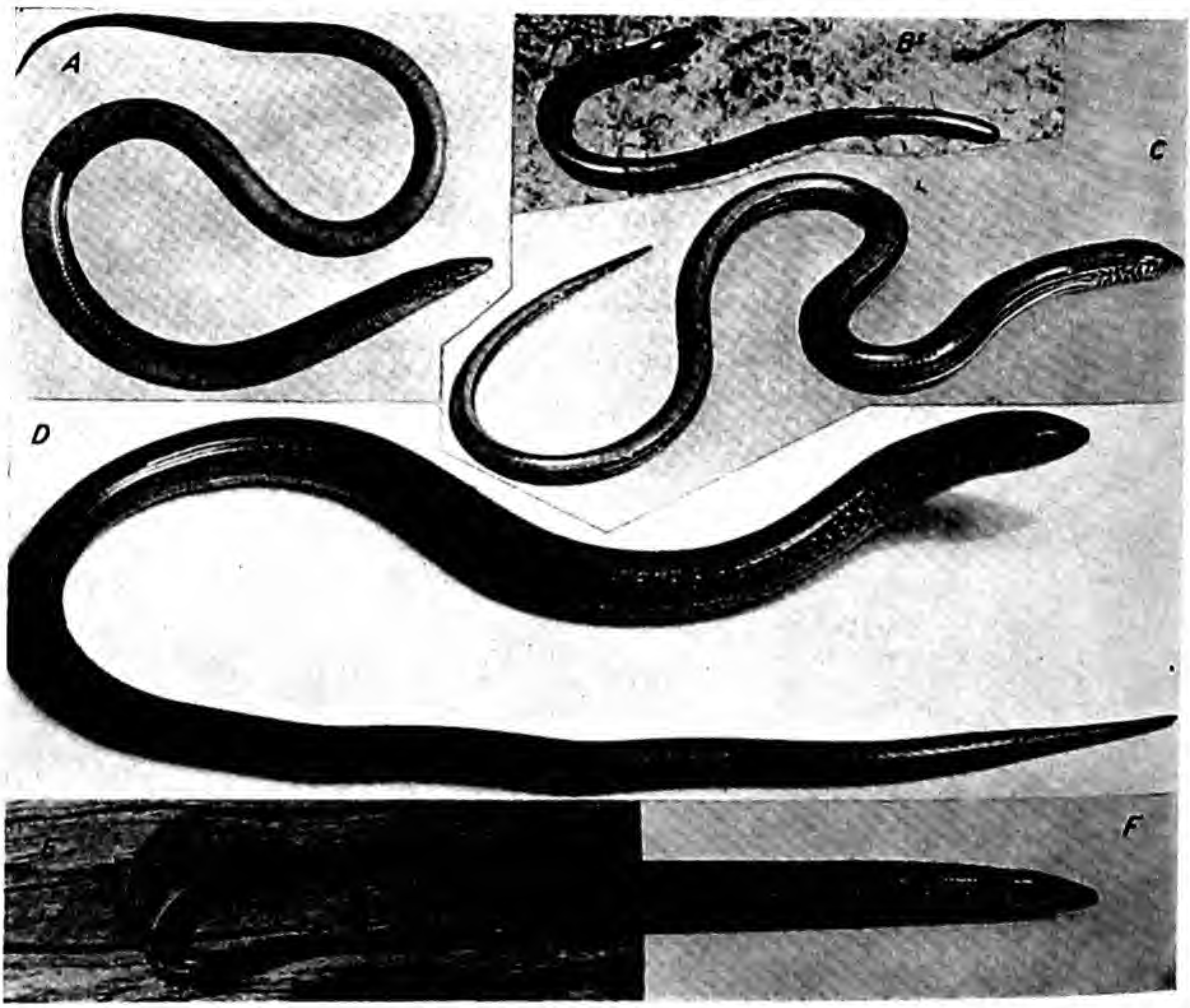
FIG. 134. Typical scutellation in *Ophisaurus*, from *O. ventralis*, locality unknown. A, top of head; B, underside of head; C, side of head; D, section of scales from side of body; E, underside at anal region. From Cope.

The sides are dark brown, the color broken only by narrow light lines extending either along the middle or edges of the scale rows. The brown lateral color fades into white or cream near the lateral fold. The sides of the neck are brown, and are either irregularly mottled or with a number of more or less irregular light lines. The sides of the head are also usually dark, at least in the temporal and subocular region, and show vertical alternating light and dark bars of varying distinctness. There are a few dark marks on the lower lips.

The back may be nearly uniform, or have a median dark stripe, or a narrow dark streak on each scale row, or even narrow, closely placed, irregular, dark and light, transverse marks. The ventral surfaces of the belly and tail are en-

tirely white, with the exception of dark streaks along the lateral scale rows in some specimens.

Scalation. See Fig. 134. The head scales are large to small, and regular in position. Eyelids are present. The ear openings are small, about halfway between the eye and the anterior ends of a deep longitudinal fold extending along each side of the belly to the sides of the anal region. The dorsal scales



Pl. 133. *Ophisaurus ventralis.* A, St. Petersburg, Florida. B, Billy's Island, Okefenoke, Georgia. C, Tulsa, Oklahoma. Gloyd photograph. D, Norias, Kennedy County, Texas. U.S. Fish and Wildlife Service photograph. E, Chesser's Island. Okefenokee, Georgia. F, St. Petersburg, Florida.

from interparietal to base of tail vary from 118 to 124, and the longitudinal rows vary from 14 to 16; those toward the middle may be convex or with a round keel. The scales in the lateral body folds are granular, usually concealed by the belly scales overlapping the lateral dorsal scale rows. The belly scales are in 10 rows, about the same size as the dorsals, but flat. The legs are missing. The tail scales are like those on body, but there is no lateral fold.

Recognition Characters. This is the only limbless lizard of the United States with a deep lateral fold. In fact, there are only two others without limbs, one

on the Pacific coast, and one in Florida. The glass snake has an elongate, tapering form, and moves like a snake; it is thus not surprising that many people believe it really is a snake. There are many characters, however, internal as well as external, that prove conclusively that the glass snake is merely a lizard without limbs. Among these are the eyelids, which no snake ever has; the ear opening, which no snake ever has; the fused halves of the lower jaw, which cannot spread laterally to accommodate large objects of food as in snakes; and many others.

Habitat. In eastern Kansas, where the glass snake is fairly common, Gloyd records that "it was found occasionally among dead leaves and decaying matter driven by the wind into brush piles and bushes. In June, 1926, one was seen in the open crawling swiftly in short grass. It took refuge in a clump of gooseberry bushes and dead leaves and escaped." In the same region I have caught specimens in grass on hillsides. They may occur in moist places, as near ponds and springs.

Habits. It is said that these lizards burrow, and are frequently found by plowing. In parts of the range they are commonly seen above ground. One specimen found in a pile of leaves attempted to escape by backing into a hole in the soft ground. There is some evidence that they are active at night. Specimens discovered during the day may actually be in hiding, as they are usually found concealed or are accidentally startled; there is no evidence that they have been discovered in normal activity. Carr is the only author who has reported seeing them resting in the open during the day, "sunning themselves on boards on concrete pavement." They are said to emerge after rains in some abundance.

The skin is shed almost entire.

The food consists of insects and their larvae, spiders and other arthropods, and small snails. Beetles may form a large part of the diet. Carr says that small snakes and lizards are eaten and that captive specimens are cannibalistic.

In captivity king snakes have been observed to eat these lizards.

The eggs vary from 8 to 17, and are laid from early June (June 2) through July (3, 22, 28, 29) to early August (August 1). The incubation period varies from 56 to 61 days. The eggs may be tapered at one end, and either or both ends may be incompletely calcified. Upon deposition the eggs measure 16.5 to 20 x 10.5 to 12 mm. (5/8 to 3/4 x 3/8 to 1/2 in.), average about 17.8 x 10.9 mm. (11/16 x 7/16 in.). At hatching the eggs average 25 x 19.5 mm., showing a greater proportional increase in width than in length. At hatching the young measure 46 to 50 mm. (1 7/8 in.) snout to vent, the tail 65 to 81 mm. (2 1/2 to 3 3/16 in.). The eggs are brooded by the females during the incubation period under cover. Females demonstrate no protective instinct, however, fleeing upon being disturbed. They move the eggs to some extent, if they are widely separated, to group them closely. The incubation does not raise the temperature of the eggs noticeably.

In North Carolina these lizards hibernate from October until late March.

According to Coe, "its lateral undulations are stiff and clumsy, and it throws its body sidewise instead of gliding like a snake. When held in the hand, its body feels hard and smooth and it creaks as the plates rub together. It attempts to escape by twisting its muscular, smooth body over and over. This is undoubtedly associated with its power of disengaging itself from its tail by a single twist when held by that organ." In fact, the chief peculiarity in habit of this lizard is readily breaking the tail into a number of pieces upon being captured. The slightest injury or rough handling causes the lizard tail literally to fly into pieces. The pieces wriggle energetically, attracting all attention while the lizard itself crawls quietly away to safety. Since the body may be only about a third the length of the whole animal, when the tail breaks in the middle it appears that the lizard itself must be flying apart. The body is not, of course, involved in the fracturing procedure, nor does it come back when the coast is clear to claim and rearticulate the various broken bits of tail. The body does regain a tail—less perfect to be sure—but it does so by growing an extension onto the stub left on the animal. A regenerated tail is always shorter than the original. Specimens are seldom found with perfect tails.

Problems. Scarcely any lizard of the United States is more commonly known and more widely distributed and yet so inadequately studied. The life history and habits are very sketchily known, even though the peculiar nature of these creatures should make a study of them of more than usual interest and importance. There are indications that several races may be recognizable.

References. Burt, 1928, pp. 36–38, habits (*Kans.*); Coe, 1944, pp. 38–41, 3 figs., description, habits (*Ind.*); Carr, 1940, pp. 73–74 (*Fla.*); Cope, 1900, pp. 494–502, figs. 88–90, description, variation (*gen. lit.*); Gloyd, 1928, p. 119, habits (*Kans.*); Noble and Mason, 1933, pp. 19–23, fig. 5, brooding habits (*lit. cit.*); Wright and Funkhouser, 1915, pp. 127–129, fig. 3, variation (*Ga.*).

The Venomous Lizards

FAMILY HELODERMIDAE

The Beaded Lizards

Genus *HELODERMA* Wiegmann

Only one genus belongs to this family, although there is a possibility that a poorly known Bornean genus should be included in it. Two species are included in the genus, one occurring along the west coast of Mexico north of the Isthmus of Tehuantepec (*horridum*), the other in southwestern United States and Sonora (*suspectum*). These are the only venomous lizards in the world.

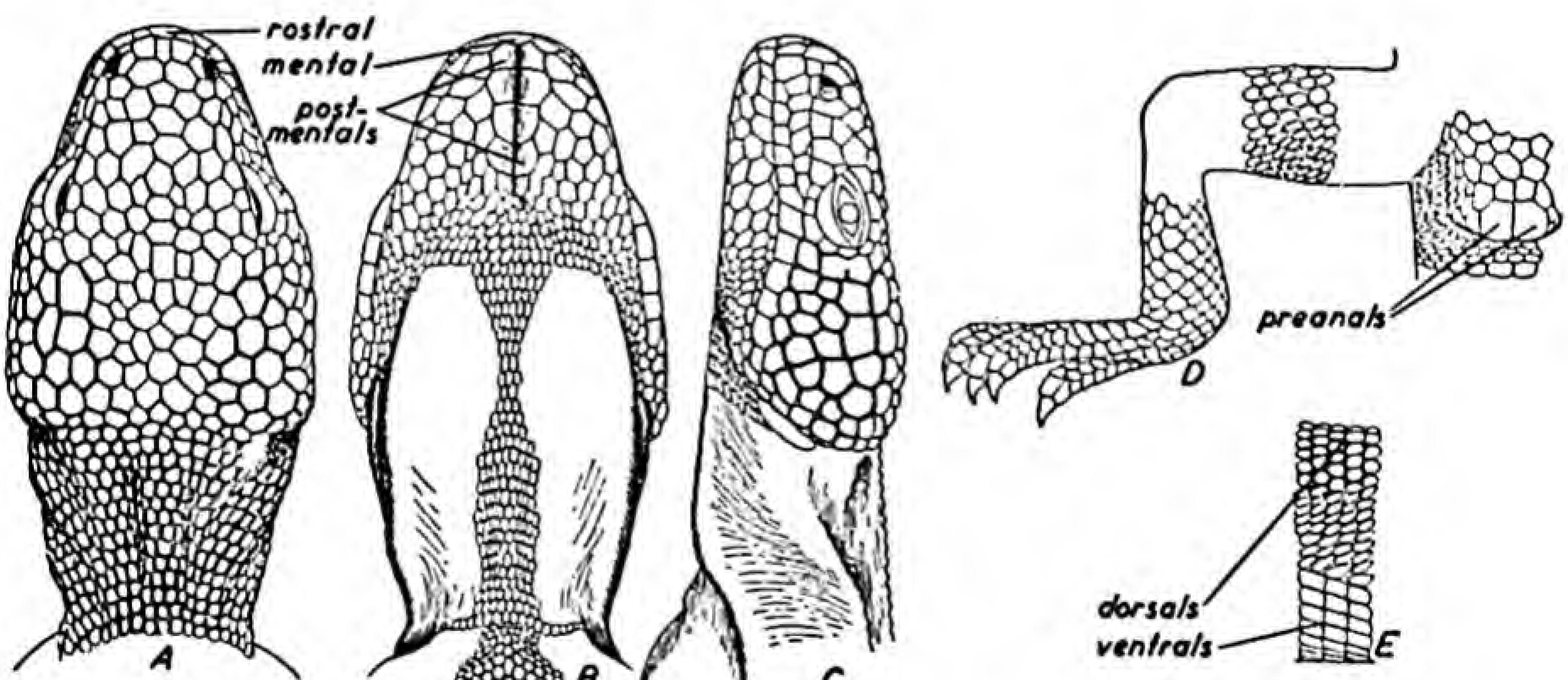


FIG. 135. Typical scutellation in *Heloderma*, from *H. suspectum*, "Arizona." A, top of head; B, underside of head; C, side of head; D, ventral view of right hind leg and anal region; E, section of body in side view. From Cope.

The characteristics of the family and genus include (1) the presence of tubercles on the sides and back of head and body, each enclosing a bony particle; (2) the small, platelike scales on the ventral surface, arranged in transverse rows and in general similar in appearance to the ventral plates of *Gerrhonotus* and *Ophisaurus;* (3) the broad, stout body; (4) the short, blunt, fat tail; (5) the union of the skull bones with the bony skin tubercles; (6) the

presence of an internal groove on all the teeth; and (7) venom glands. The last is the character of most general interest, for the venomous properties of the genus *Heloderma* are not duplicated in any other lizards known, except perhaps *Lanthanotus*. In spite of the common belief that many of our species are venomous, none except *Heloderma* possess any venomous qualities whatever. Some features of the scalation of a typical species are shown in Fig. 135.

Arizonan Gila Monster *Heloderma suspectum* Cope

(Figs. 15, 16, p. 63; Fig. 135; Pl. 134)

Range. Extreme southwestern Utah and extreme southern Nevada, south through Arizona to northern Mexico (Sonora). Type locality—Sierra de la Union, Arizona. There are various records from the states of Texas, Arkansas, Kansas, and perhaps others, but these are undoubtedly based upon escaped pets. (Map 40, p. 512.)

Size. The largest specimen of which I find record had a total length of 24 inches, of which I estimate about 16 inches was head and body. Accurate measurements of a large, but not maximum-sized, specimen give 345 mm. (13½ in.) for the head and body, 150 mm. (5⅞ in.) for the tail. The body is almost cylindrical, the head somewhat flattened. The limbs are equal, chubby but somewhat small, the hind leg usually very slightly the longer; the body is about 3³⁄₁₀ times as long as the limbs. The tail is fat and heavy.

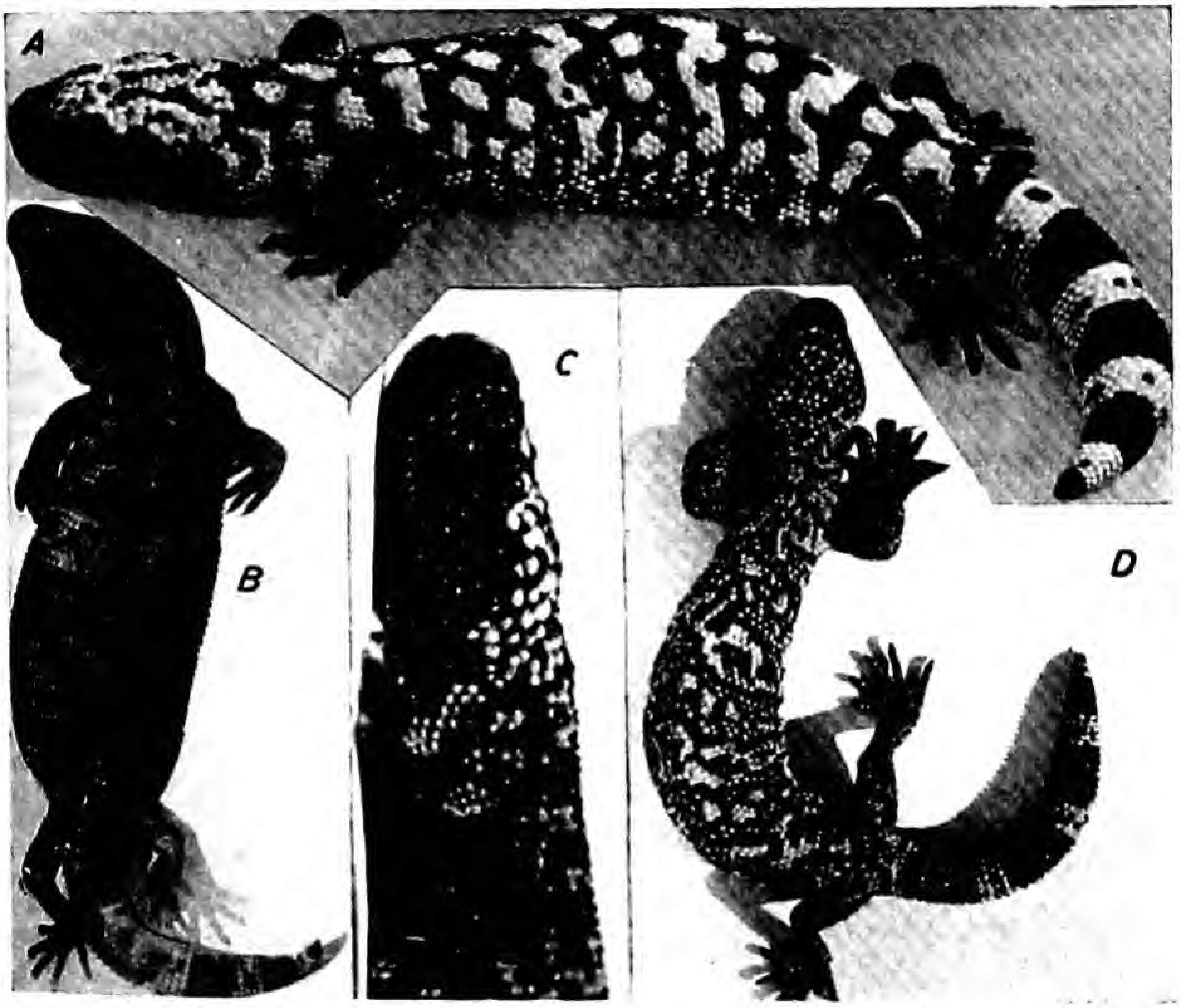
Color. The body is marked above and laterally with a coarsely reticulated, irregular pattern of brown or black upon a yellow to salmon or orange background. The light areas are about equal in extent to the dark areas, or a little more extensive. The legs are mostly black, with scattered light spots and a few larger areas of light color near their insertion. The tail has usually about 4 dark rings, a little broader than the light rings. The sides and lower surfaces of the head are a uniform black. The belly has irregular dark marks, many of which tend to group into narrow, transverse streaks associated in 3 or 4 transverse groups. The feet and hands are black, the other ventral surfaces variably spotted.

Scalation. See Fig. 135. The head, body, and limbs are covered above by fairly large, rounded, convex tubercles, those on temporal region largest, all narrowly separated from each other by scaleless skin. The tubercles tend to be placed in transverse rows, which merge with somewhat larger, flattened, ventral scales. The tubercles on the limbs, toward the hands, tend to overlap to some extent. The labial scales are but little enlarged. The eye is small. The ear opening is about as long as the orbit but very narrow, the skin extending anteriorly over the posterior part of the opening. There are no femoral pores, rarely a preanal pore.

The scales of the lower jaw near the tips are somewhat enlarged, and that area is expanded somewhat, so that from the dorsal view the lower jaw ex-

tends laterally beyond the margin of the upper jaw. This swelling indicates the position of the venom glands of the lower jaw.

Recognition Characters. The "beaded" character of the skin so often noted, the coloration, and the peculiar body form render this lizard one of the most easily recognized of all United States species. Frequently confused with it are the small ground geckos, which may have a reddish color, dark crossbands, and a body form similar to that of the Gila monster. Although there are in-



Pl. 134. *Heloderma suspectum*. A, Gleason, Arizona. Gloyd photograph. B, C, Santa Rita Mountains, Arizona. D, Ruby, Arizona.

numerable differences between these two species, the arrangement of the belly scales in straight transverse rows is perhaps the most easily defined character separating the Gila monster from the ground gecko, in which the ventral scales are arranged in longitudinal and diagonal rows.

Habitat. This odd, lumbering species inhabits the flat desert floor or valleys and broad canyons in desert mountains. In the Tucson region, where Ortenburger once collected sixteen specimens, "most of them were in the sahuaro-ocotillo association; either in canyons or on the ridges between them; several

were found in the level desert floor in the mesquite association; and one was in the irrigated region northwest of Tucson at the edge of an alfalfa field." In recent years it is said to have become fairly rare. It probably is nearing extinction in many parts of the United States owing to persistent persecution.

Habits. The most celebrated characteristic of the Arizona Gila monster is its venomous property, shared among lizards only with a very close southern relative of the same genus, the Mexican Gila monster (there is possibly one other venomous species, in Borneo, but certainly no others). How and why this faculty arose is a question, for it serves no use in food getting since these extraordinary creatures seem to eat eggs more than anything else. Loeb demonstrates that the venom is neurotoxic in action, affecting the nervous system and accordingly the function of the heart and respiratory vessels. However, the exact toxicity or strength of the venom has never been agreed upon by scientists. Some maintain that its poison is equivalent in deadliness to that of rattlesnakes, whereas others, although admitting the actual fact of toxicity, maintain that no death of a human has ever been caused directly by the bite from one of these lizards. Several deaths allegedly due to the venom or its aftereffects have been proved to have been provoked probably as much by a weakened condition of the subject as by the venom itself. For arguments on various aspects of this problem and further references, see Van Denburgh and Storer. Viaux describes another bite case.

The glands which secrete the venom are in the lower jaw, where the lips are swollen. The venom is secreted into the mouth between the teeth and the lips, through separate openings opposite the anterior 3 or 4 teeth on each side, and unless the lizard retains its hold for a considerable period, permitting the venom to find its way by sheer chance into the wounds caused by the large teeth, there is little opportunity for the full effect of the venom to be realized. Although the teeth in the lower jaw, as well as in the upper jaw, are grooved, these grooves have no connection with the poison sac or gland; they may aid in affording a place for the venom to work into the wound by capillary action. The grooves occur on both the front and rear of the teeth; the front groove is the deeper.

The food of the Gila monster in nature is not well known. Stomach analyses give poor results, but parts of a lizard, a race runner, were once found. Yet small lizards introduced into cages with Gila monsters are totally ignored. Bird eggs are eaten, and it is said that in spite of their clumsiness these lizards have been seen to climb low bushes, presumably searching for birds' nests. In captivity they can live for years upon a diet of hens' eggs. They refuse everything else. They do not molest most animals which may be in their cages, but they have been reported as having killed two rattlesnakes.

Apparently Gila monsters are primarily of nocturnal habits, although they may be found at almost any time of day. I have seen them most frequently near dusk. While generally slow-moving, they can snap their heads sideways

in attempts to bite with extraordinary rapidity. In captivity they become tolerant of handling except when placed in the sun, whereupon they regain much of their original capabilities of sudden, unexpected movements. Ortenburger reports that these lizards are powerful diggers, scraping the sand away by slow, persistent movements of the forelegs. It is believed that they do not ordinarily dig their own quarters, however, but use mammal holes. The digging proclivities may be most useful in their natural habitat by enabling them to reach water in dry arroyos. Oddly, although this is a desert creature, it shows a strong liking for water. In captivity it spends as much time in as out of water, and if deprived of water soon languishes and dies (Kauffeld).

Kauffeld states that it occasionally sleeps on its back, with the legs widely spread, and that this habit is very pronounced in the southern species.

Reproduction is by means of soft-shelled eggs about two and one half inches in length, which are said to vary in number from five to thirteen. It is stated that the female digs a hole from three to five inches deep in moist sand in some spot exposed to the sun's rays and usually near a stream, and, having deposited her eggs therein, scrapes back the sand until they are entirely covered. The period between laying and hatching is given as about a month, and the young were about four inches long when they escaped from the eggs (Van Denburgh).

Specimens have been kept in captivity for 19 years and 4 months.

Problems. The life history of this, the most extraordinary lizard of the country, offers a most inviting problem.

References. Kauffeld, 1943, pp. 345–346 (*Ariz.*); Loeb, 1913, pp. 1–244 (*lit. cit.*); Ortenburger, 1926, pp. 108–110 (*Ariz.*); Storer, 1931, pp. 12–15 (*lit. cit.*); Van Denburgh, 1922, pp. 471–476, pls. 44–47, *gen. lit.*); Viaux, 1939, pp. 17–19 (*lit. cit.*).

The Shovel-snouted Legless Lizards

FAMILY ANNIELLIDAE

Genus *ANNIELLA* Gray

This is another family represented by only a single genus, containing three forms. In this case the genus is almost completely restricted to the United States—in fact, to California. It extends into Baja California a short distance.

The genus and family are characterized by the absence of external evidence of limbs, the absence of even internal evidence of the fore limbs, the absence of an ear opening, the presence of lidded eyes, and the uniform scalation of the body on all sides with smooth, rounded, overlapping scales like those of a skink. The scales have bony internal plates (osteoderms). The teeth are few and elongate. Certain features of the scalation of a typical member of the genus are shown in Fig. 136.

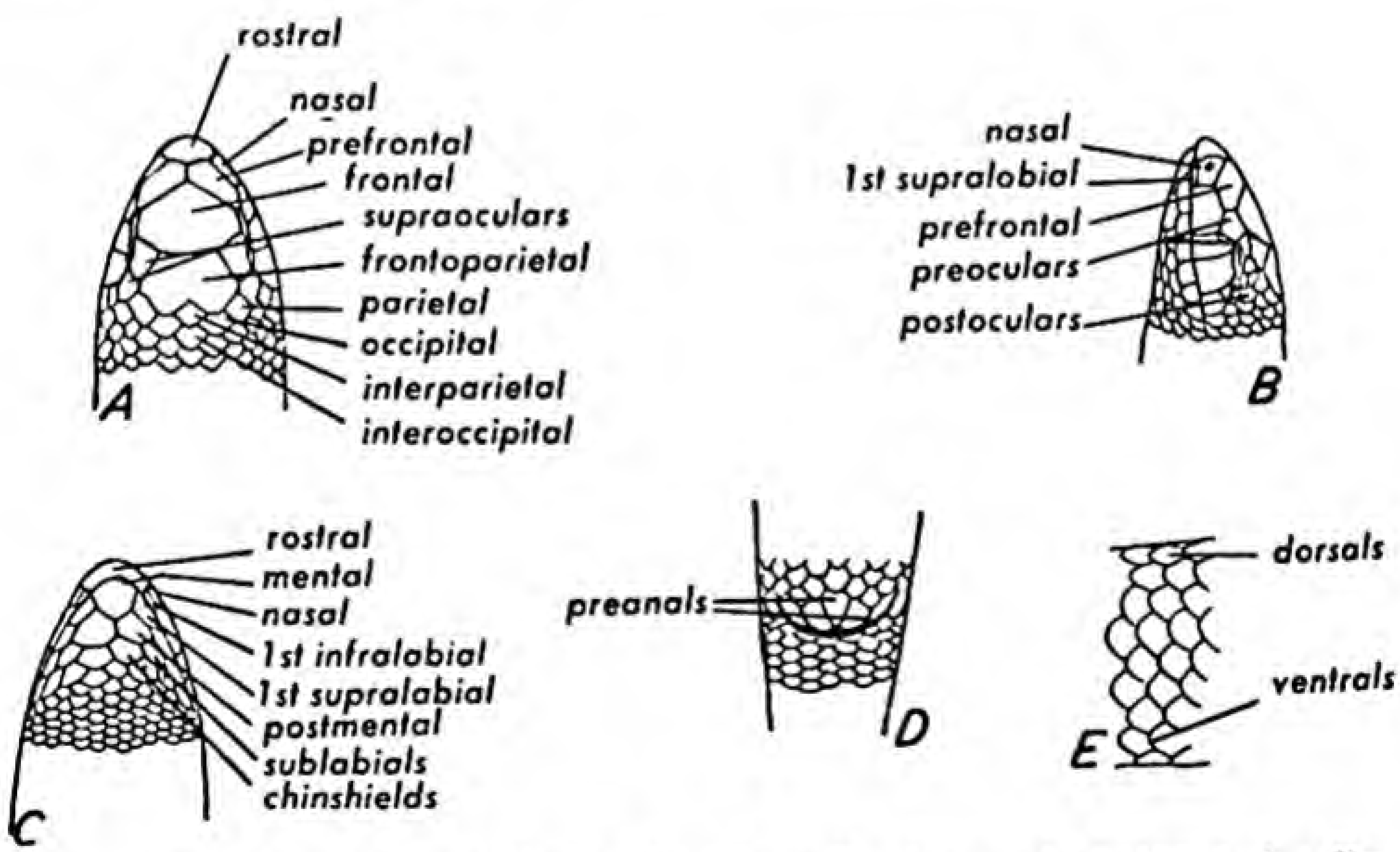


FIG. 136. Typical scutellation in *Anniella*, from *A. pulchra*, locality unknown. A, top of head; B, side of head; C, underside of head; D, underside at anal region; E, scales at side of body. From Cope.

This is one of three genera of limbless lizards in the United States. One, *Ophisaurus*, has both eyes and ears well developed; *Anniella* has eyes, with lids, but no ears; and *Rhineura* lacks both eyes and ears. The genus is ovoviviparous (young are born instead of being hatched).

KEY TO SPECIES OF *ANNIELLA*

1. In specimens over about 120 mm. (4 ¾ in.) snout to vent, dorsal color hair brown, or darker (to black), generally not silvery; tail rarely more than half snout-vent length . . . . *pulchra nigra* (p. 479)
   In specimens over 120 mm., dorsal color silvery drab or silvery wood brown; tail rarely less than half head-body length, when complete and unregenerated . . . . *pulchra pulchra* (p. 477)

Silvery Footless Lizard *Anniella pulchra pulchra* Gray

(Figs. 4, 5, p. 61; Fig. 136; Pl. 135 B–F)

Range. Contra Costa County south to northwestern Baja California, and on the east side of the San Joaquin Valley north to Fresno and the Sequoia National Park. Type locality—California. (Map 40, p. 512.)

Size. Maximum snout-vent length about 150 mm. (5¾ in.); tail ½ to ⅔ the head-body length, or 32 to 42 per cent (average 37 per cent) of the total length. Limbs absent. Maximum diameter about 6 mm. (¼ in.).

Color. Dorsal color of light shades, from yellowish white or silvery to buffy brown, and from brownish olive to light brownish drab; a narrow, mid-dorsal, black line, and 2 or 3 dark lines on the sides, one on the inner and another on the outer edge of the fifth scale row (and edges of adjacent rows), and the outer (if present) on the adjacent edges of the fifth and sixth scale rows. The median line is usually darker than the lateral lines. In addition there may be usually less well-defined, lighter, secondary, dark lines on the adjacent edges of the other scale rows, ventral as well as dorsal; these may be absent, poorly defined, or almost as well defined as the primary dark lines. The belly is somewhat lighter than the dorsal surface, usually less intensely marked (if at all), yellowish in life. The markings continue on the tail, but are more distinct there. The regenerated tails are a uniform, dark, purplish brown. The head, both above and below, is pigmented with dark brown, the color shading posteriorly into the lighter markings of the body.

Scalation. See Figs. 5 and 136. Scale rows 30 anteriorly, 26 medially, 16 near anus; all scales on body smooth, equal in size, imbricated, rounded; no ear opening; eye very small, lidded; tail of same diameter as body, tapering slightly.

Recognition Characters. The fact that there is some semblance of an eye opening guarded by movable lids removes this snakelike lizard from the true snakes. The absence of the ear opening and the limbs separates it from all others, except the other member of its genus. The Monterey Peninsula race, *p. nigra*, can be distinguished by its usual possession of a very dark dorsal color, light belly color, and dark color of the ventral surface of the tail and head; it also has a tail usually less than half the snout-vent length (see dis-

cussion of the black race). The silvery tone in adults and subadults of *p. pulchra* is very characteristic.

Habitat. Generally sandy soil, either open or covered by a xerophytic growth (even to pine forests), is inhabited, although the species may be found also in dense soil or amongst rocks. In Tulare County it reaches 5400 feet in elevation. It is highly adapted to burrowing and apparently emerges upon the surface of the ground very rarely. A more or less loose soil is thus obviously preferable for ease in burrowing. In the areas where it occurs the moister sands are chosen, as near beaches, under bushes, boards, etc. If these lizards inhabit the sand of open dunes or deserts, away from cover which may tend to preserve some greater humidity than elsewhere, it is not known. Yet extremely arid regions are inhabited, where the rainfall does not exceed 3 inches a year.

Habits. These lizards lead an almost exclusively underground life, for which their shovel-shaped mouth and partly countersunk jaws are adapted. They are generally found a few inches below the surface under boards, cardboard, bushes, debris, or other protection, where they can be found by raking the soil. Almost all known specimens have been taken by excavating; only a very few have been found on the surface, yet it has been recorded that, where they are abundant, the sand may be seen marked with their tracks. When raked from the soil they burrow again with extraordinary rapidity—so fast that they must be grabbed quickly to prevent their escape. A specimen held in the hand "squirms violently, seeking any crevice into which the head may be thrust. Failing this, it twists laterally as do racers when similarly held. Sometimes it bites and the tiny teeth can be felt" (Klauber).

The tongue is lavender and to project it this species opens the mouth slightly, as do other lizards but not snakes, which protrude the tongue through a permanent slit that dispenses with the necessity of opening the mouth each time. The eyelids remain closed while the lizard is under sand.

The limbless lizards eat the larvae of insects, small adult beetles and spiders. They feed on the surface of the ground or just below it, usually in the leafy litter under bushes.

Anniella is ovoviviparous, the young being born in September, October or November. There are from one to four young produced at one time (an average of 1.7 embryos were taken from eight females).

There are four age groups: young of the year, immature, subadult and breeding adult. These lizards are probably two or three years old before they breed.

Before shedding, the black lizards become light blue. Ecdysis follows this stage in two to six days, and is usually completed two or four days later. Moisture is essential to shedding. The blue pre-shedding color is evident only on the longitudinal stripes in the silvery lizards.

Anniella is parasitized by a nematode (Oxyuroidea: Thelandros) in the colon, and a cestode (Anoplocephalinae: Oochoristica) in the stomach and intestine. No external parasites have been found.

Locomotion is accomplished only by lateral undulations of the body. Progression is chiefly under-ground.

The special senses which are apparently especially well developed are smell and touch. Anniella shows no phototropisms.

These fossorial lizards are usually found in a temperate climate, in the Upper Sonoran and Transition Life-zones. They usually occur in sand hills or in rolling country in fine-textured soils. Cover is essential and is usually in the form of bushes, leaf droppings beneath bushes, boards, or debris.

The activity of Anniella is controlled by temperature. The optimum temperature is from 15° C. to 25° C. Below 13° C. the lizards are inactive, although they can stand a temperature of 4° C. Above 40° C. is lethal. The lizards bask in the warm sand during the day. They are active and feed in the afternoon and evening.

Moisture is essential to the existence of Anniella. The optimum condition is dry sand overlying damp soil (of soil moisture from 2 to 8 per cent the total weight of the raw soil sample), where the lizards can move freely from one to the other. Saturated soil is not habitually entered.

The usual depth of habitation of the limbless lizard is from one to four inches. The animals will penetrate as deep as the moisure and the compactness of the earth will permit, however.

Anniella is closely dependent on plant associates. Vegetation provides cover, retains moisture near the surface of the ground and directly or indirectly supports the soil fauna on which the lizards feed.

The limbless lizards apparently occur in localized areas. They are sedentary, the individuals not moving far (from 1.8 to 27.5 feet for ten lizards in two months time).

Moisture is a major factor limiting their distribution. Other factors are temperature, soil texture, vegetation and agricultural practices (Miller, 1944).

Problems. The life history and anatomy of these lizards are still incompletely known.

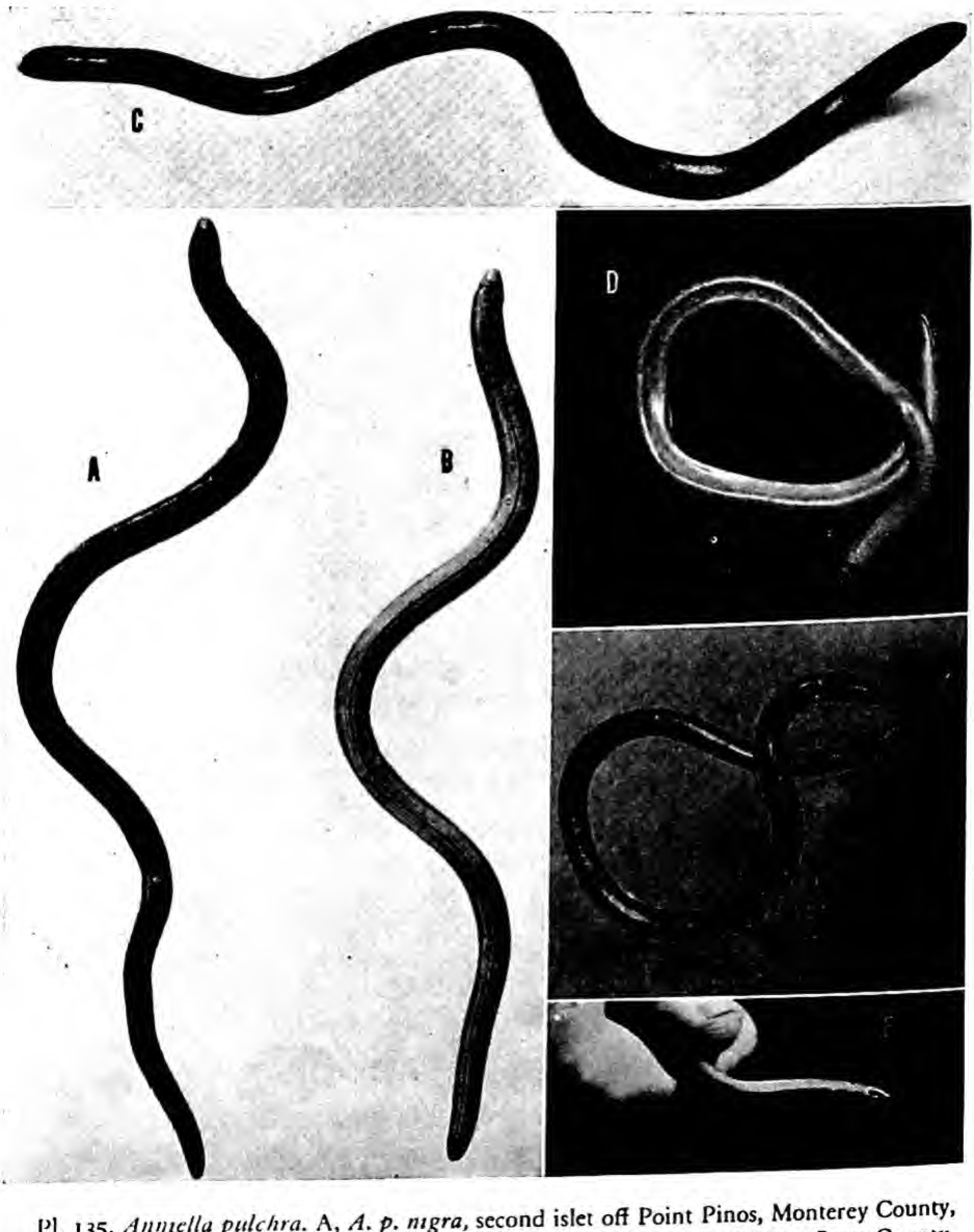
References. Burt, 1931, pp. 105–106, habits (*lit. cit.*); Hanley, 1943, p. 146, feeding (*lit. cit.*); Klauber, 1932, pp. 4–6, habits, summary of localities (*lit. cit.*); *idem,* 1939, p. 96, table 15, habits, color (*Ariz.*); *idem,* 1940, pp. 15–16, intergradation, color, habits (*Calif.*); Miller, 1943, pp. 2–6, intergradation, color (*lit. cit.*); *idem,* 1944, pp. 271–289, ecologic relations and adaptations (*lit. cit.*); Van Denburgh, 1922, pp. 465–467, pl. 42, description, range, localities (*gen. lit.*).

Black Footless Lizard *Anniella pulchra nigra* Fischer
(Pl. 135 A)

Range. The Monterey Peninsula and vicinity, of central California. Type locality—"San Diego," but in error. (Map 40, p. 512.)

Size. Maximum recorded snout-vent measurement 163 mm. (6⅜ in.). The tail is about ⅓ to ½ the snout-vent length, or between 26 and 36 per cent (average 31 per cent) of the total length.

Color. Usually the dorsal color is a nearly uniform, very dark brown or black, covering about 10 to 14 scale rows and then merging with the light yellow color of the belly. The head is very dark below, and sometimes the ventral surfaces of the tail may be heavily pigmented. The belly may have very feeble evidence of longitudinal dark streaks.



Pl. 135. *Anniella pulchra*. A, *A. p. nigra*, second islet off Point Pinos, Monterey County, California; top view. B–F, *A. p. pulchra;* B, 2 miles east of Antioch, Contra Costa County, California, top view; C, Ontario, California, side view; D (underside), E (top side), San Diego County, California; F, no locality, side view of head and neck. Figs. A–C, U.S. Fish and Wildlife Service photographs.

In some specimens of *p. nigra* the 3 primary lines typical of *p. pulchra* may be present, and the ground color considerably lighter. This is particularly true of young specimens, which may with difficulty be distinguished by color from *p. pulchra*. Fisher describes the color change as follows:

In the young individuals of this species there is a general silver tone with distinct dorso-lateral dark lines and sometimes a dark mid-dorsal line of varying length. As they become more mature the dorsal surface loses the silver tone and the dorso-lateral lines become indistinct as quantities of melanin are deposited in this area. The very light yellow ventral surface intensifies to a chrome yellow with brownish throat and with or without dark brown scales on the ventral surface of the tail. In very young specimens the skin on the ventral surface is so thin and the amount of pigment so little that the color of the internal organs may be seen through it, and, in general, secondarily influence the color of the ventral surface in their region.

After death the color of all parts fades and most rapidly when preserved as museum specimens. The yellow of the ventral surface becomes a pale yellowish white at the same time that the preserving fluid becomes a chrome yellow.

Scalation. As in *p. pulchra* (Fig. 136); the head scales may frequently be fused in various ways.

Recognition Characters. The possession of eyelids, however feeble, and the absence of the ear openings and of the limbs identify this race and separate it from all except the silvery race that surrounds it. From the latter it may be distinguished mainly by dorsal color; that of the silvery race is much lighter, and 3 dark lines are clearly defined in adults as well as young. As was noted above, however, young specimens of *p. nigra* are marked and colored like *p. pulchra*, no matter from what part of the range they have been taken. Such young specimens can be identified by locality or by reference to the tail character, providing the tail is complete and not regenerated. It is essential that the tail be entire and unregenerated for the difference in its length to be utilized as an identifying character. In the black race the tail is almost always less than half the snout-vent length; in the silvery race it is almost always more than half the snout-vent length. The black race reaches a greater head-body length than the silvery race.

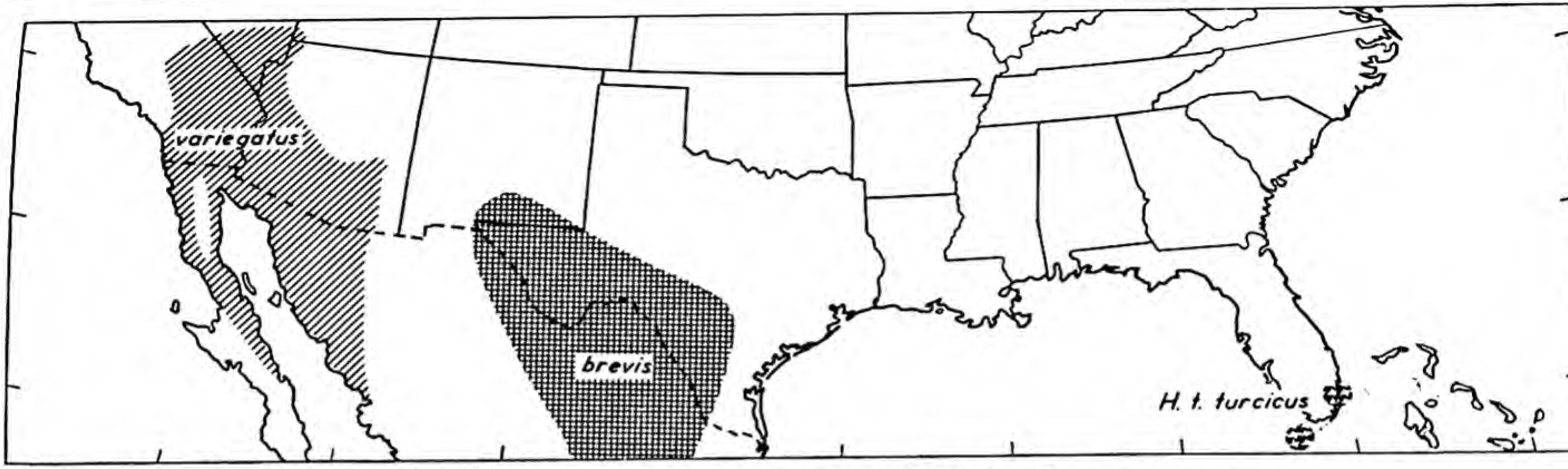
Habitat. Sandy soil in semiarid regions, into dry pine forests. Much the same as for the silvery race.

Habits. Presumably the same as those of the silvery race.

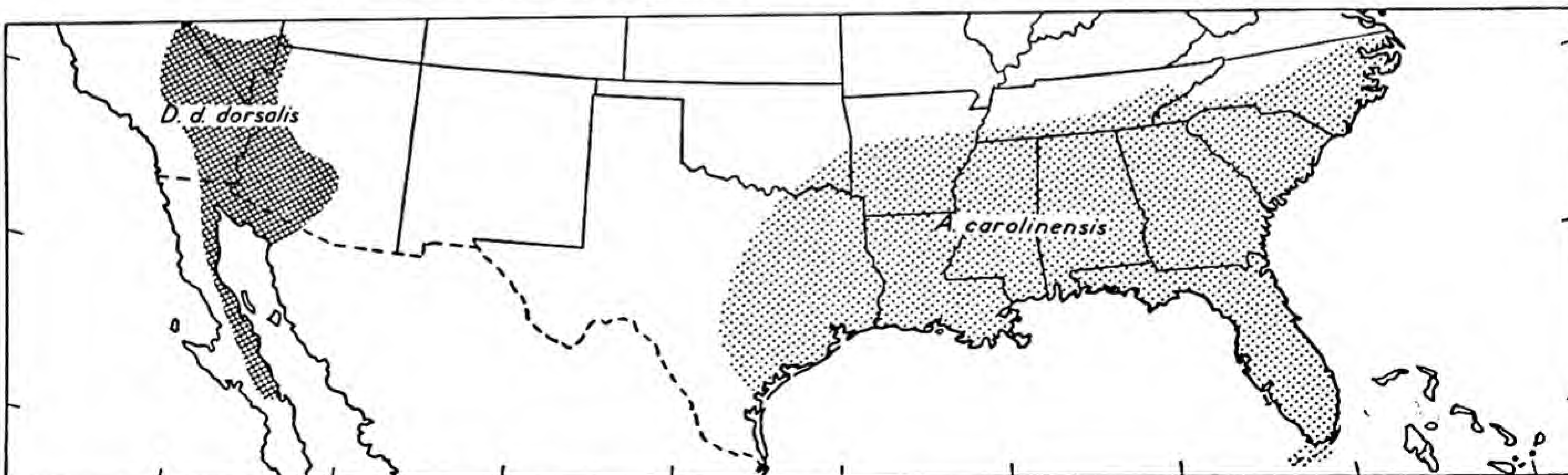
Problems. As previously discussed. Grinnell and Camp cite a record from Marin County, which may belong to *p. pulchra* or even *p. nigra*, but which has been lost in recent treatments of the genus. This is at the extreme northern part of the range.

References. Fisher, 1934, pp. 47–49, color (*lit. cit.*); Grinnell and Camp, 1917, p. 170 (*Calif.*); Miller, 1943, pp. 2–6, map, intergradation, color (*lit. cit.*); Van Denburgh, 1922, pp. 467–470, pl. 43, description, range, localities, habits (*gen. lit.*).

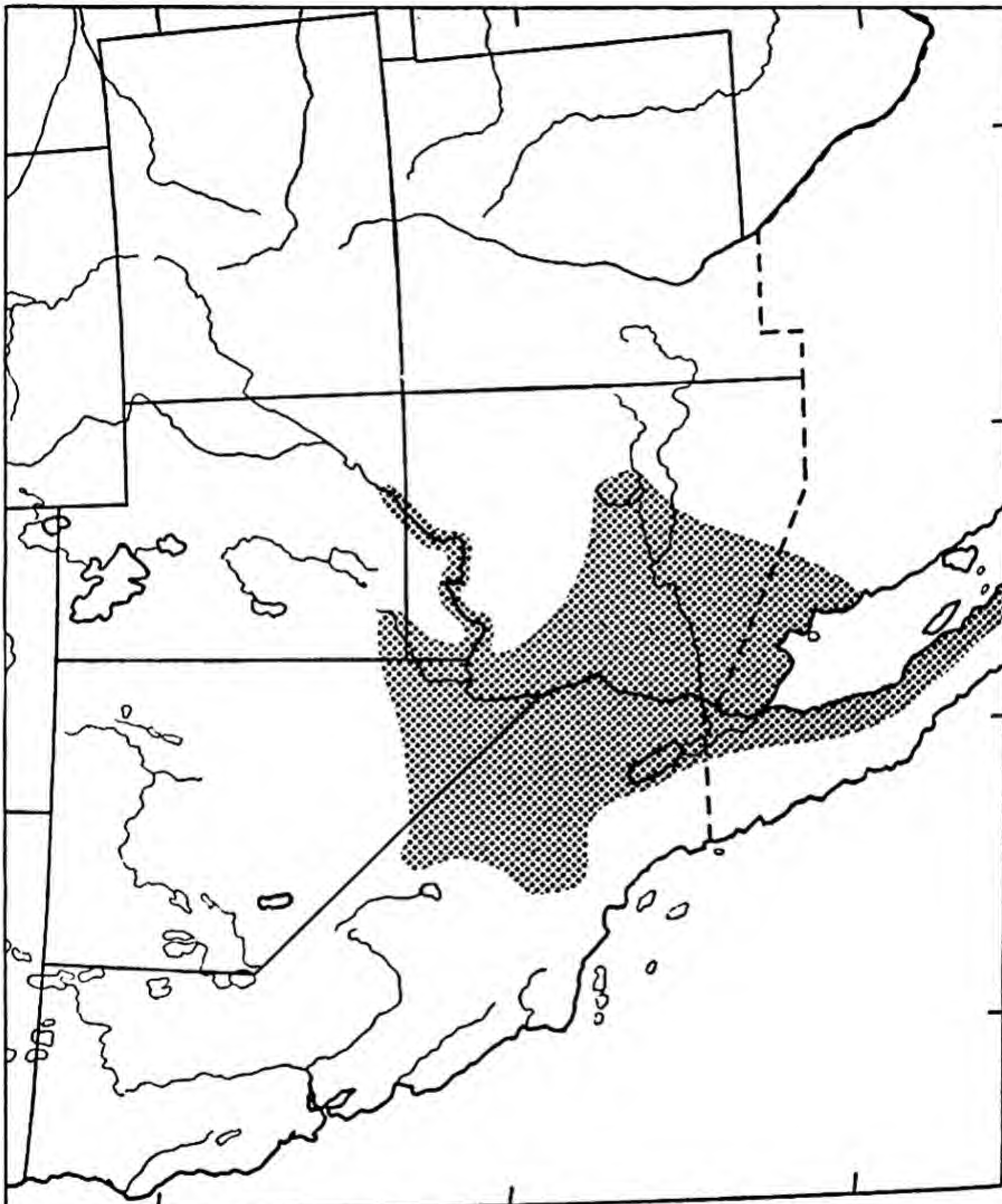
DISTRIBUTION MAPS OF LIZARD SPECIES IN THE UNITED STATES AND CANADA



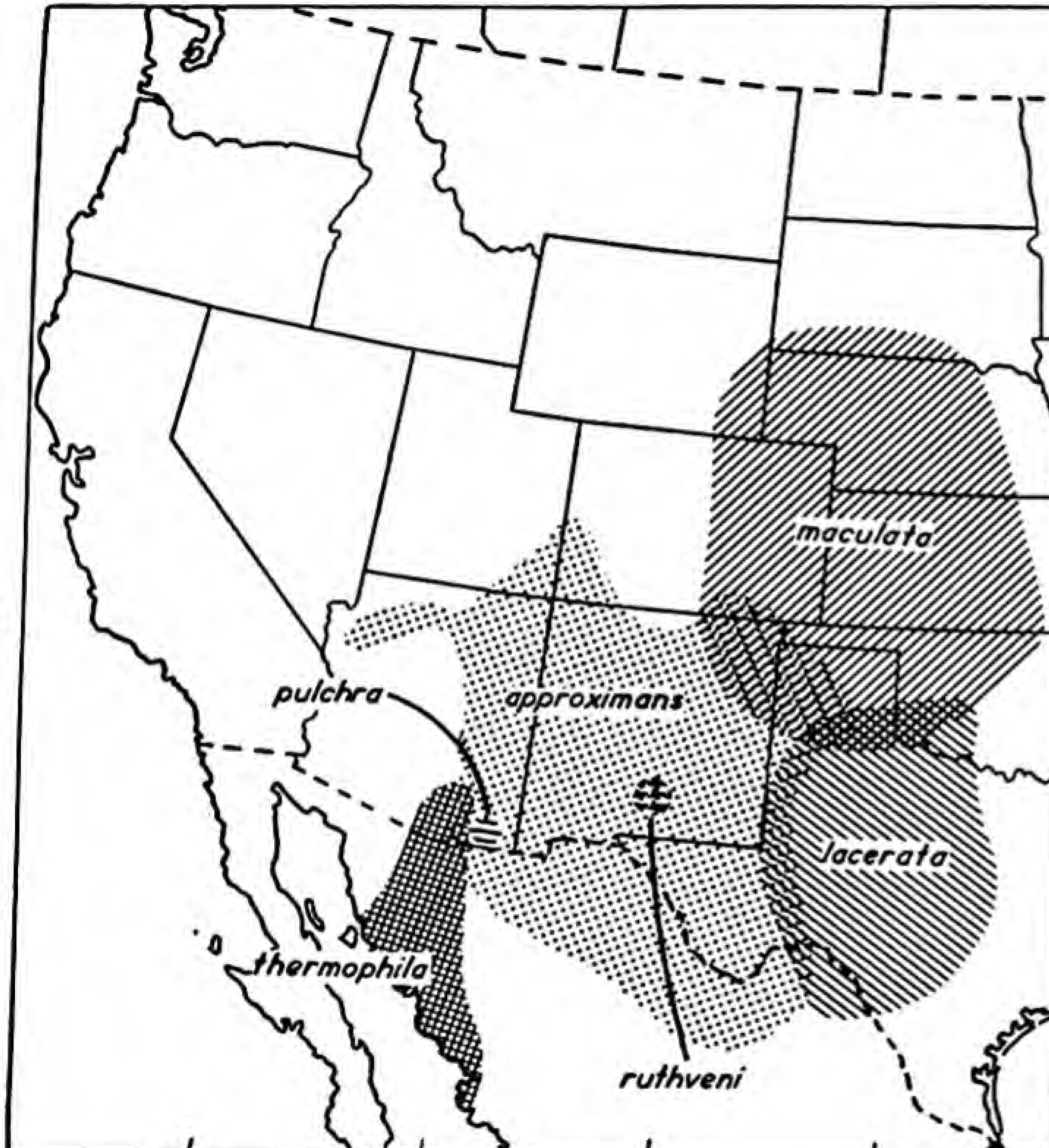
Map 1. Distribution of *Coleonyx brevis, C. variegatus,* and *Hemidactylus t. turcicus.*



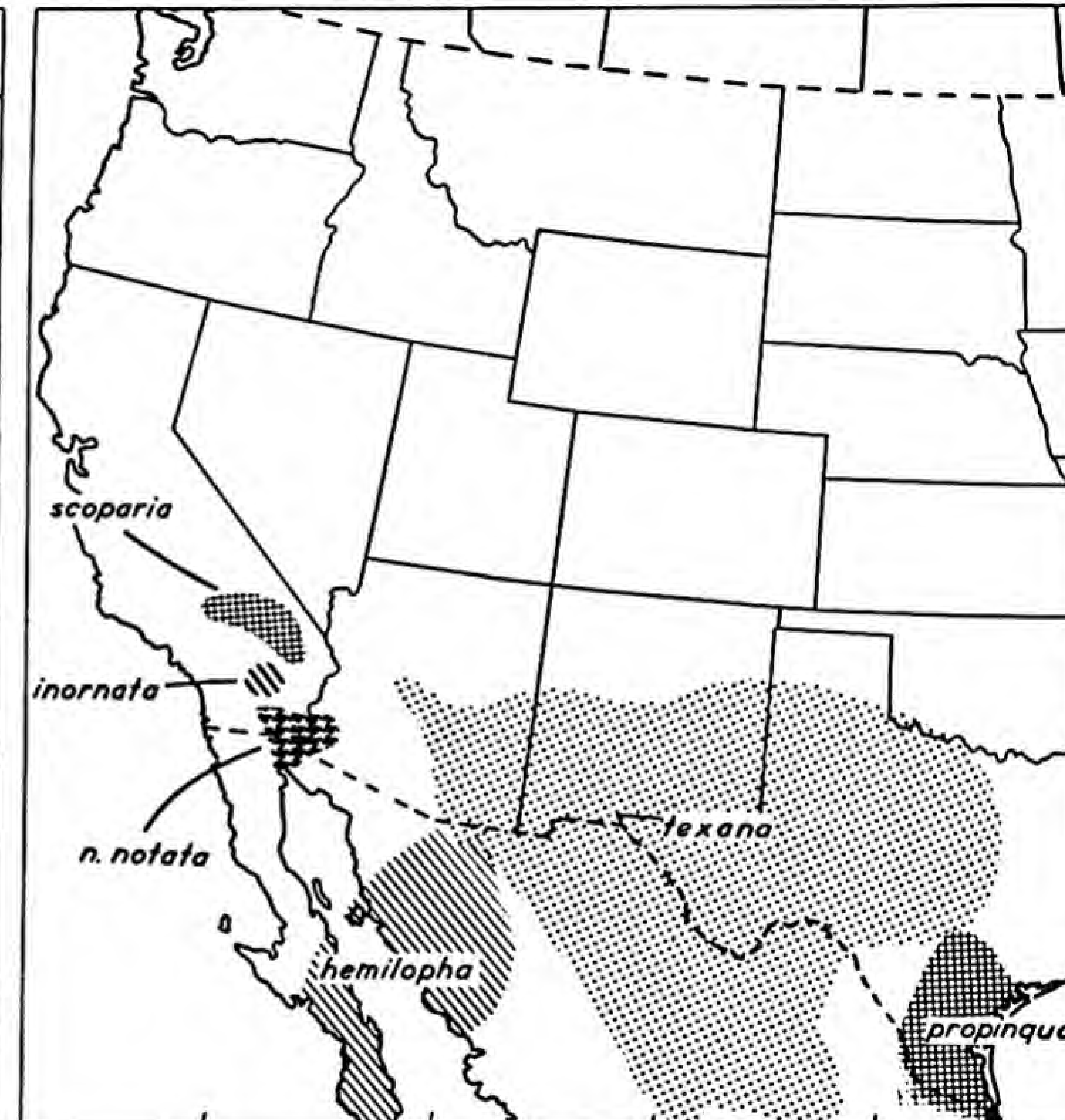
Map 2. Distribution of *Dipsosaurus d. dorsalis* and *Anolis carolinensis.*



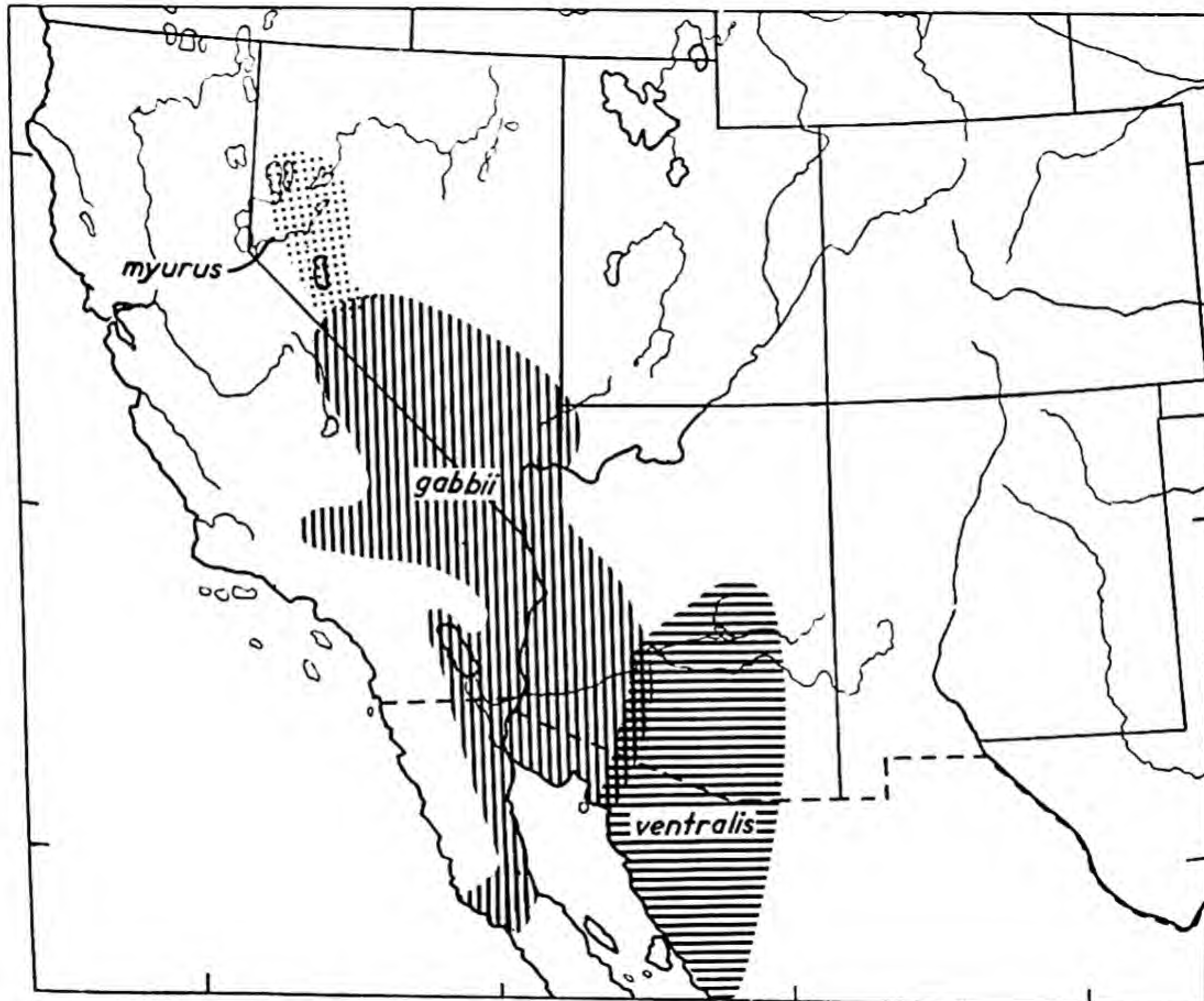
Map 3. Distribution of *Sauromalus obesus.*



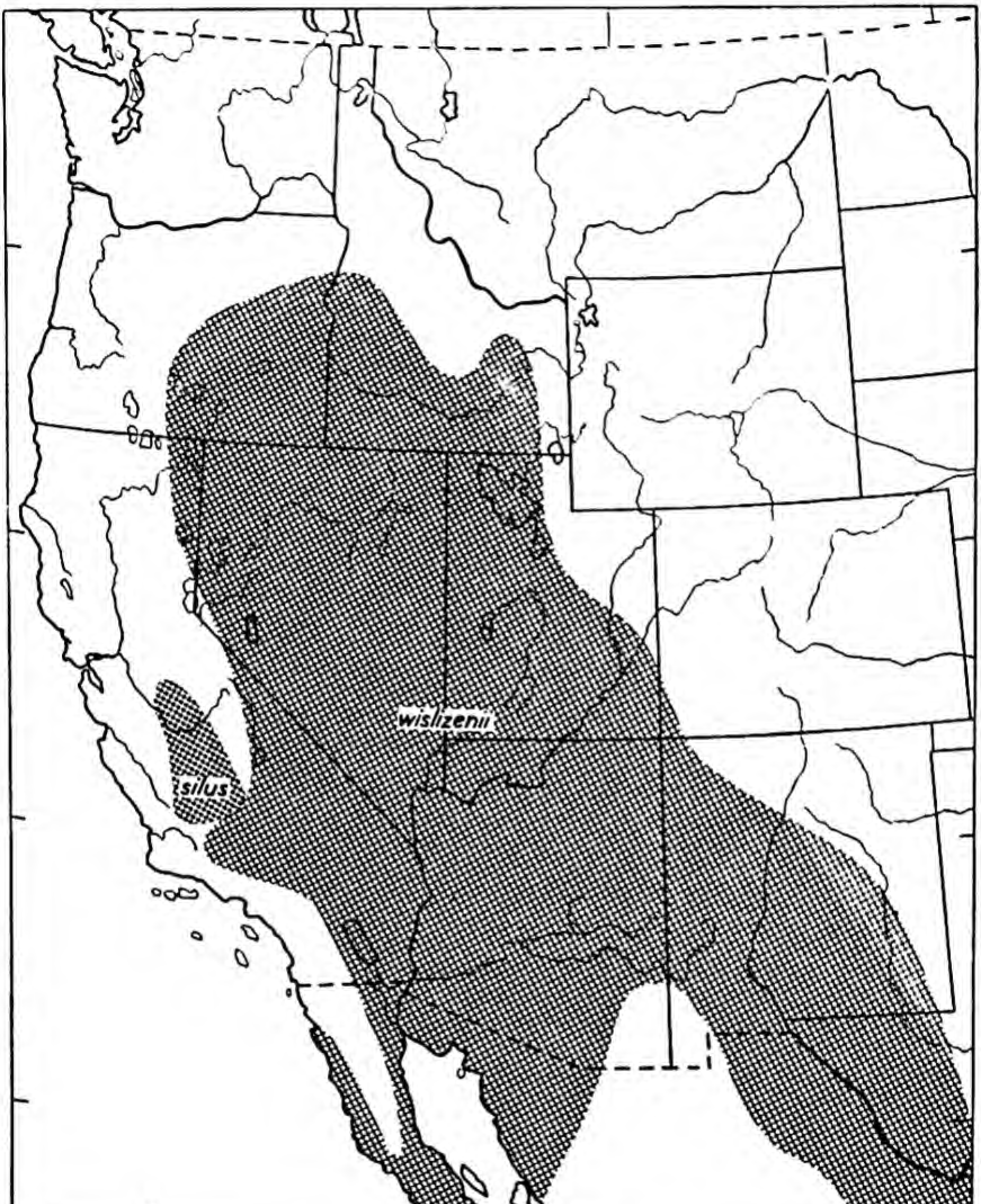
Map 4. Distribution of the subspecies of *Holbrookia maculata.*



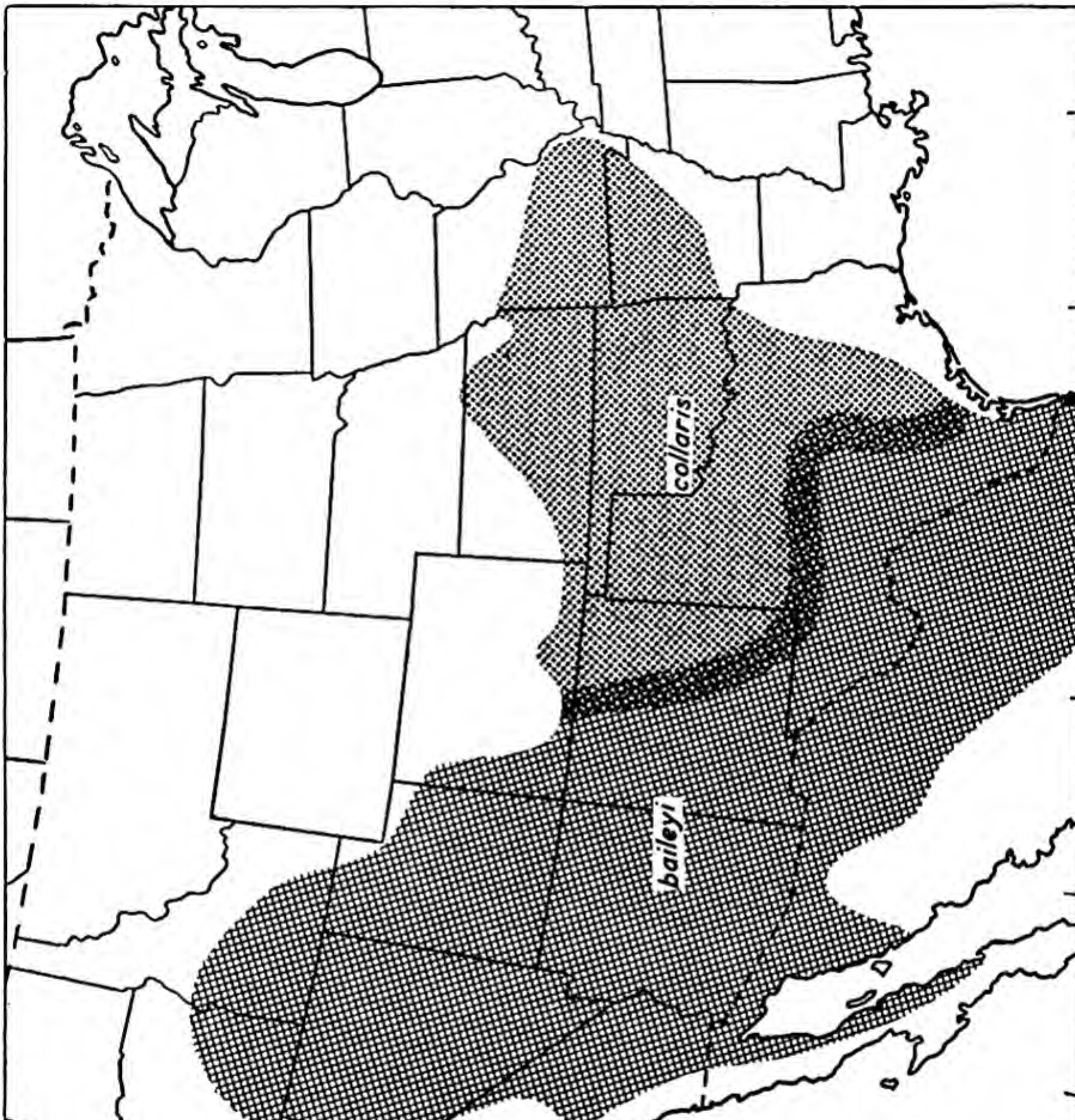
Map 5. Distribution of *Ctenosaura hemilopha, Holbrookia propinqua, H. texana,* and the species of *Uma.*



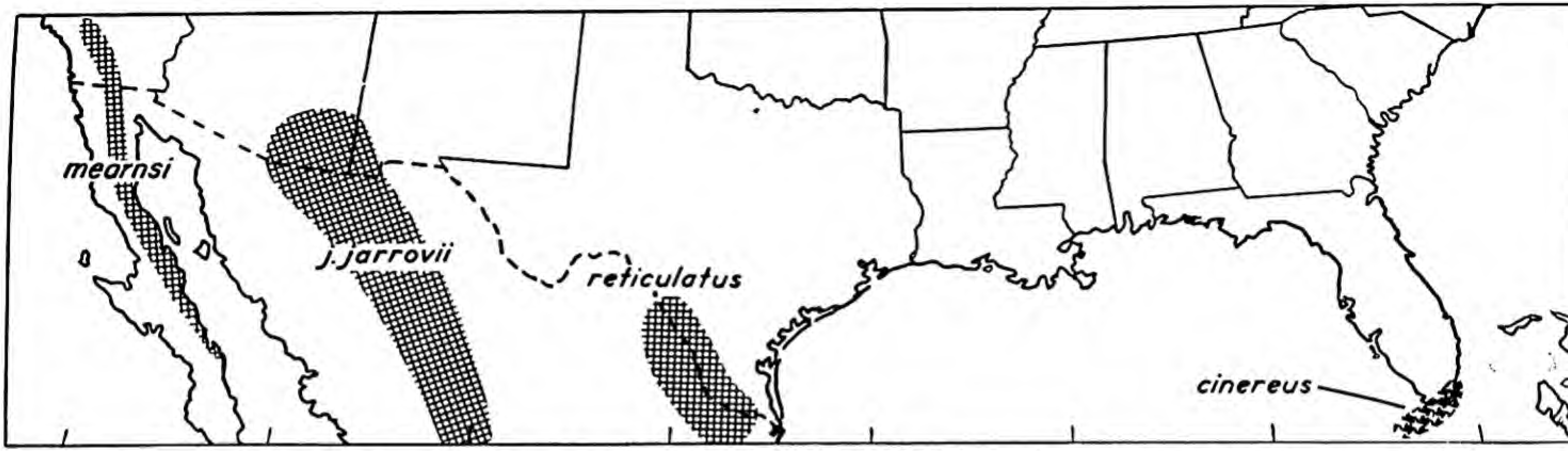
Map 6. Distribution of the subspecies of *Callisaurus draconoides*.



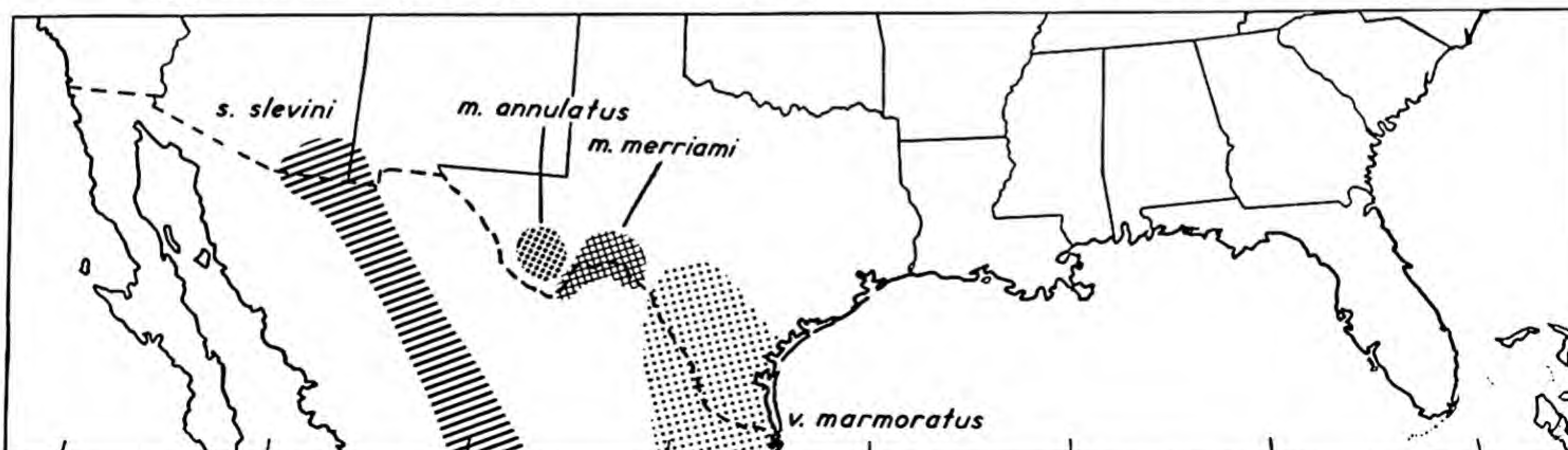
Map 7. Distribution of the subspecies of *Gambelia wislizenii.*



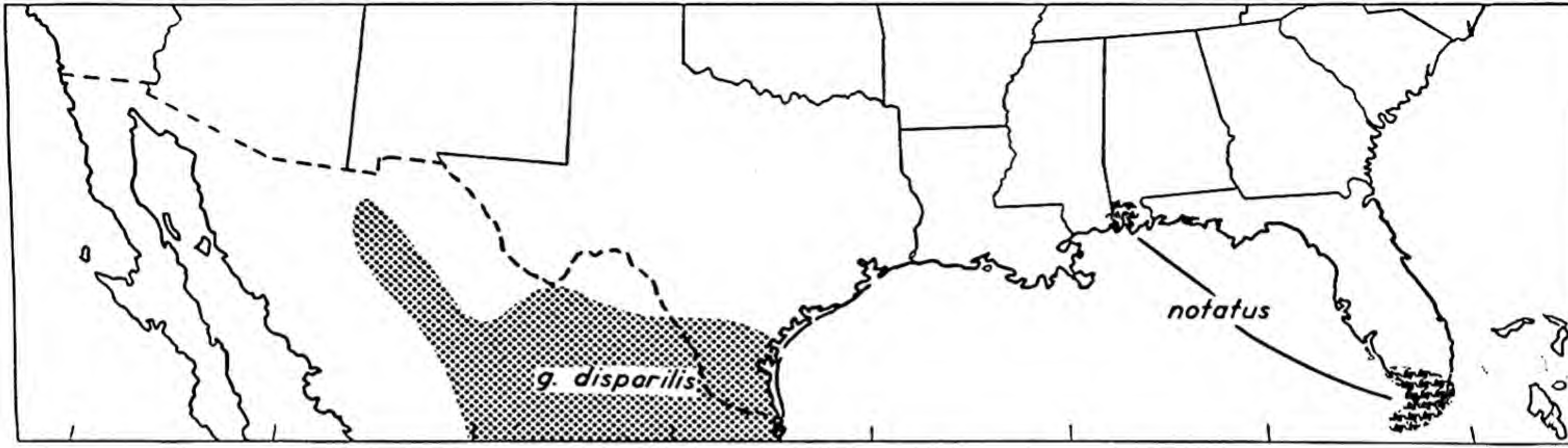
Map 8. Distribution of the subspecies of *Crotaphytus collaris.*



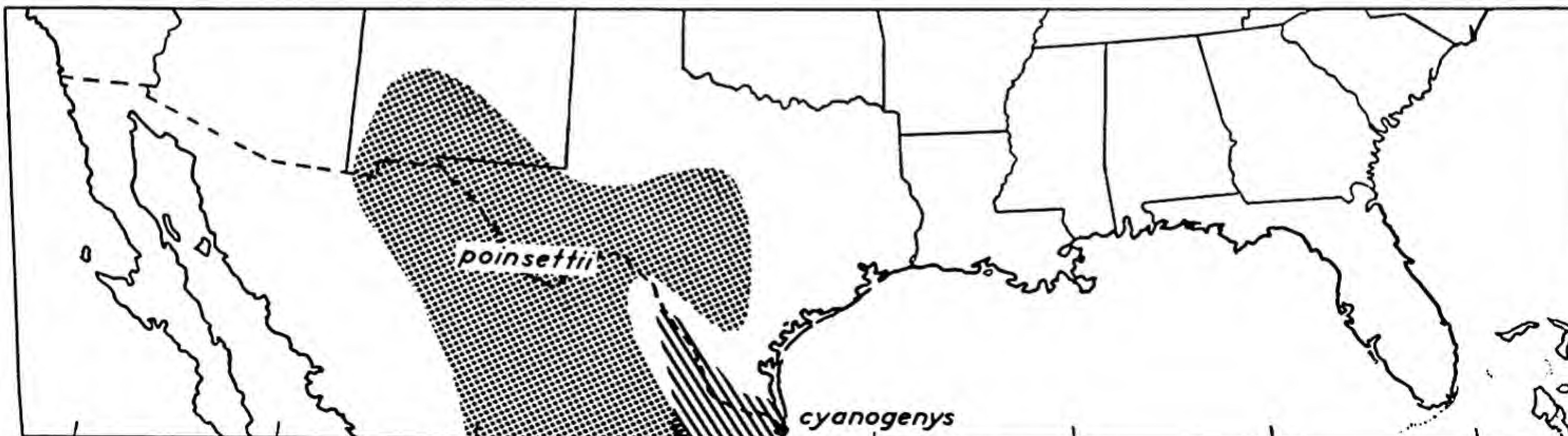
Map 9. Distribution of *Sphaerodactylus cinereus*, *Crotaphytus reticulatus*, *Sceloporus j. jarrovii*, and *Streptosaurus mearnsi*.



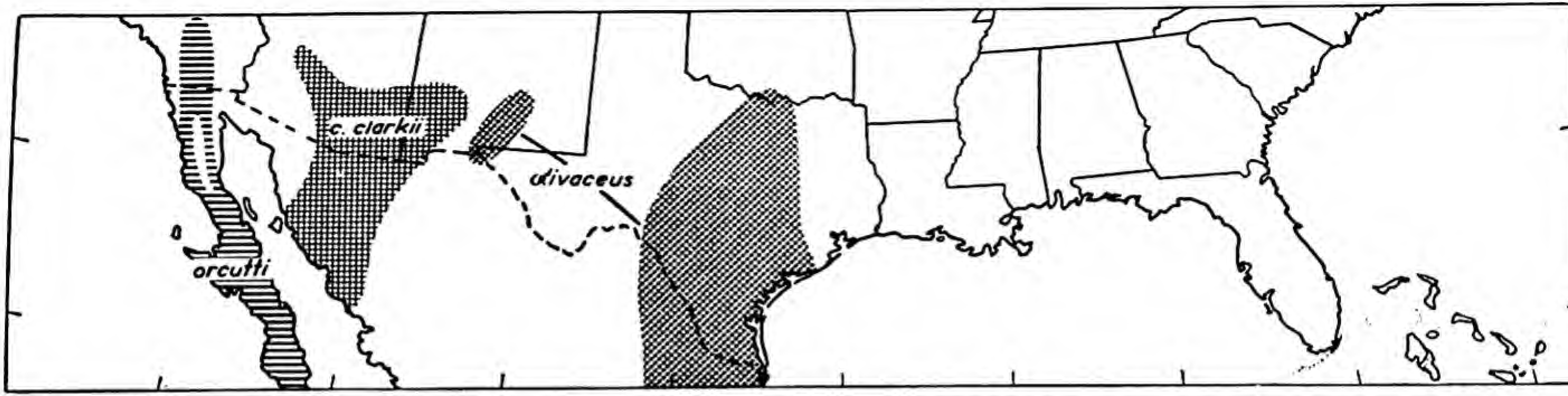
Map 10. Distribution of the subspecies of *Sceloporus merriami* and of *S. scalaris slevini* and *S. variabilis marmoratus*.



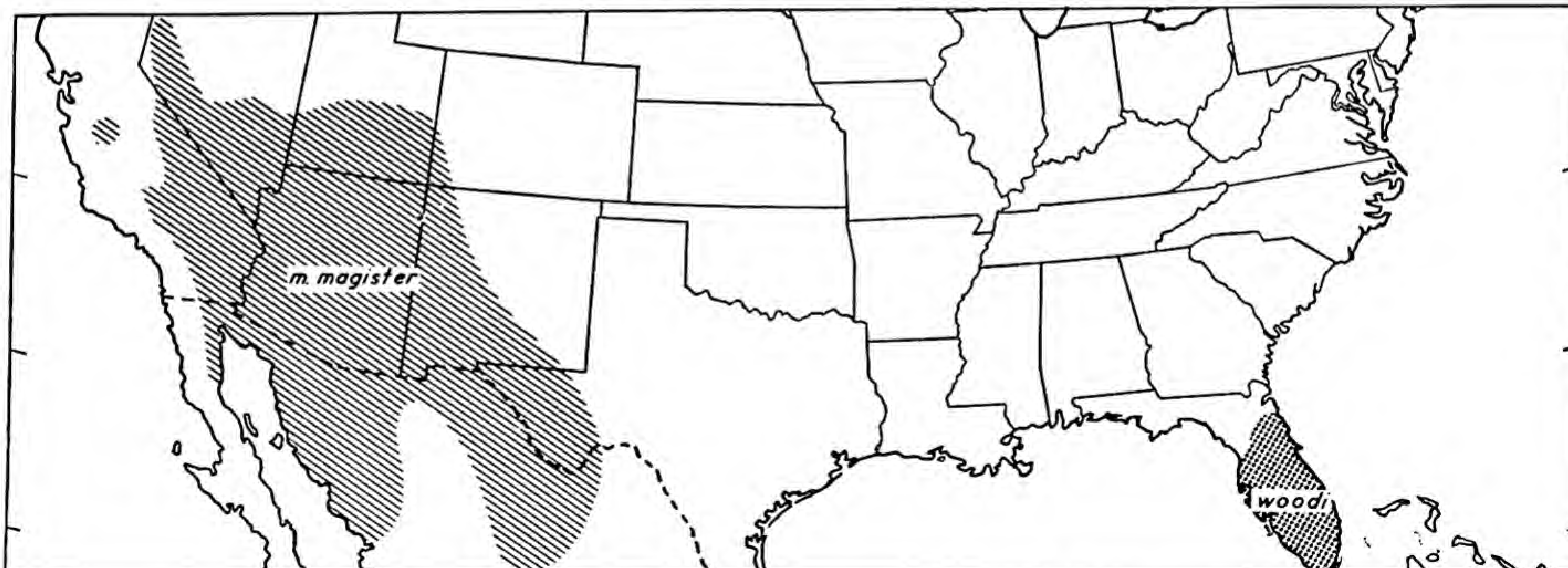
Map 11. Distribution of *Sphaerodactylus notatus* and *Sceloporus grammicus disparilis.*



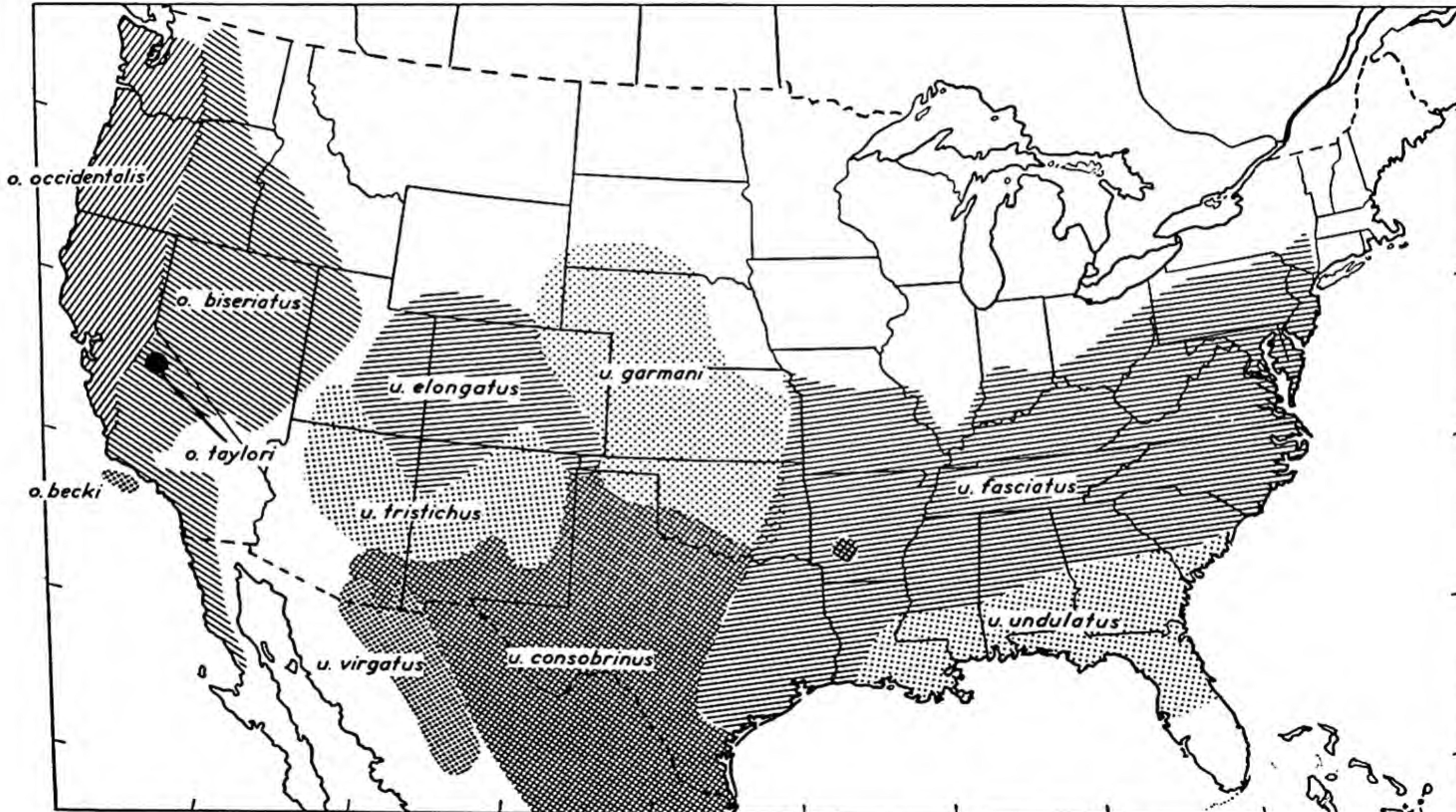
Map 12. Distribution of *Sceloporus poinsettii* and *S. cyanogenys.*



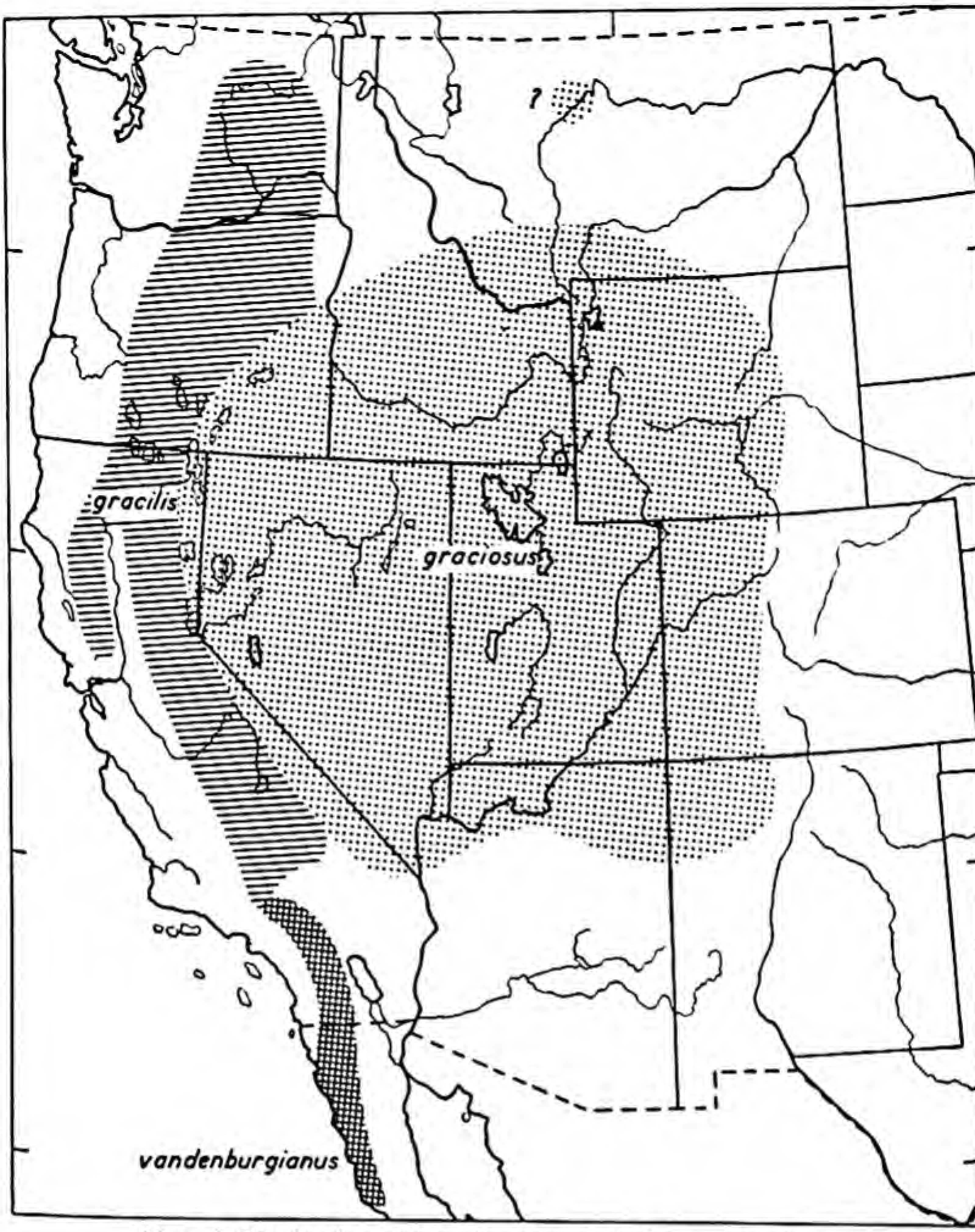
Map 13. Distribution of *Sceloporus orcutti*, *S. c. clarkii*, and *S. olivaceus*.



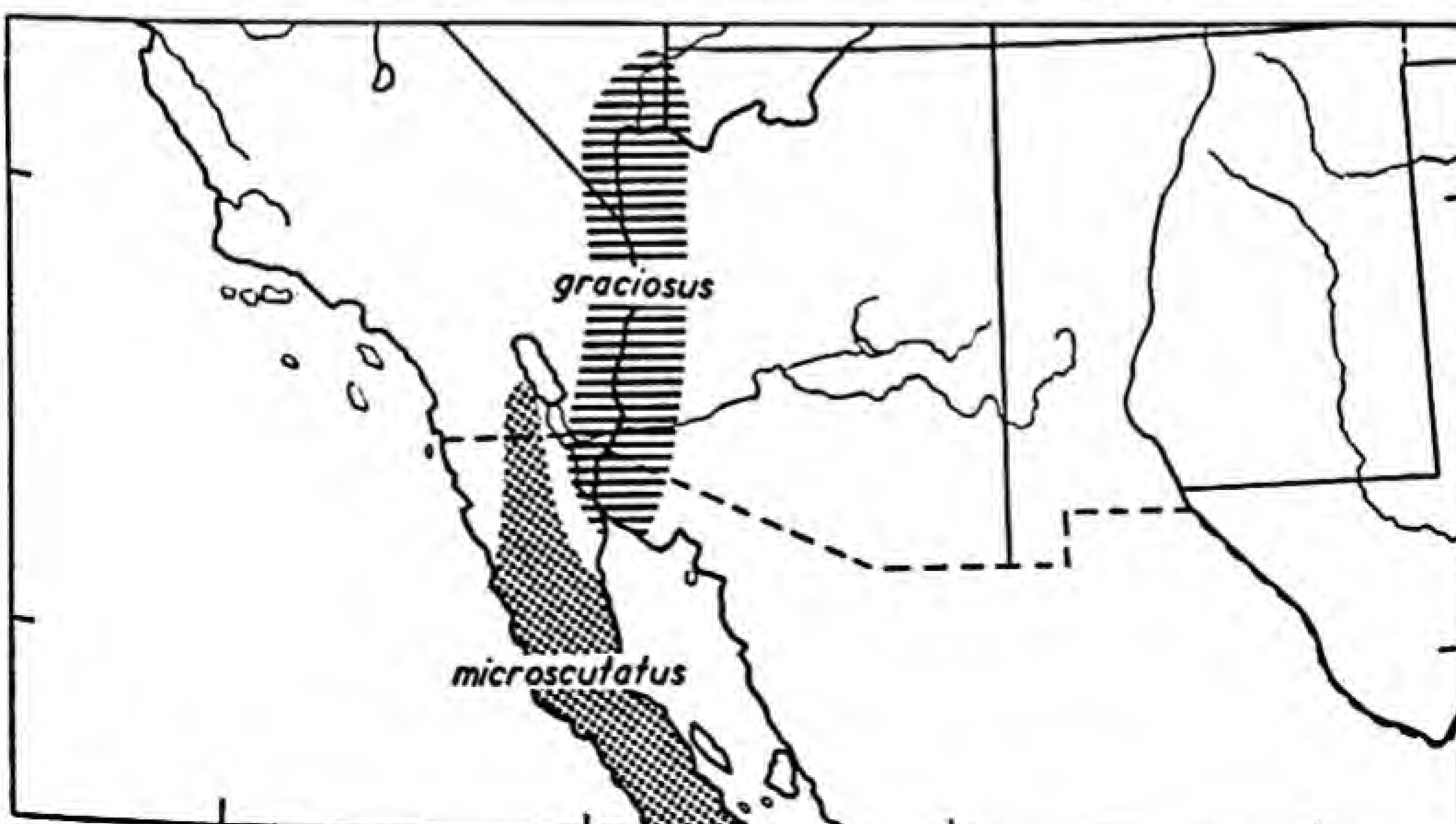
Map 14. Distribution of *Sceloporus m. magister* and *S. woodi*.



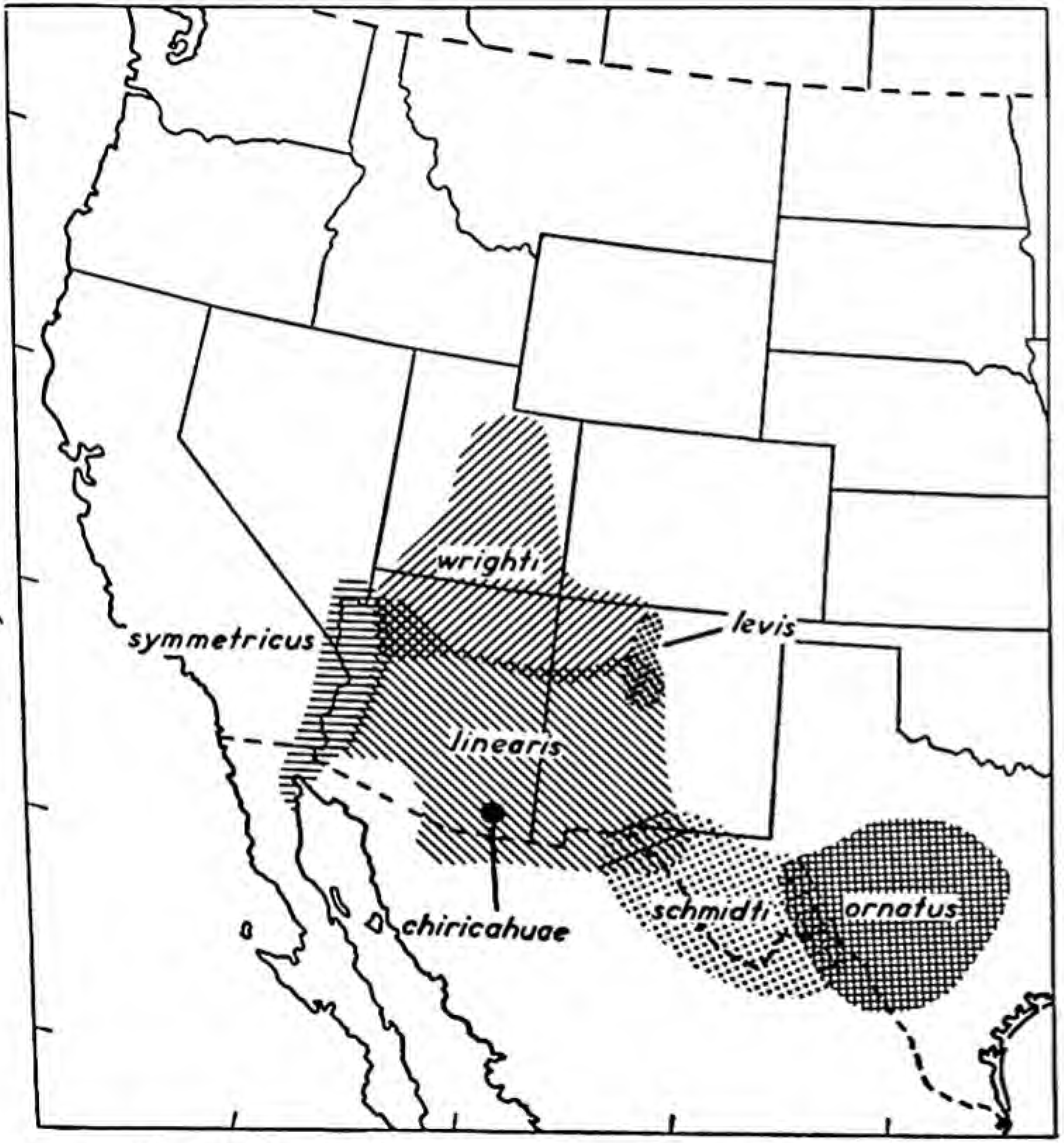
Map 15. Distribution of the subspecies of *Sceloporus undulatus* and of *S. occidentalis*.



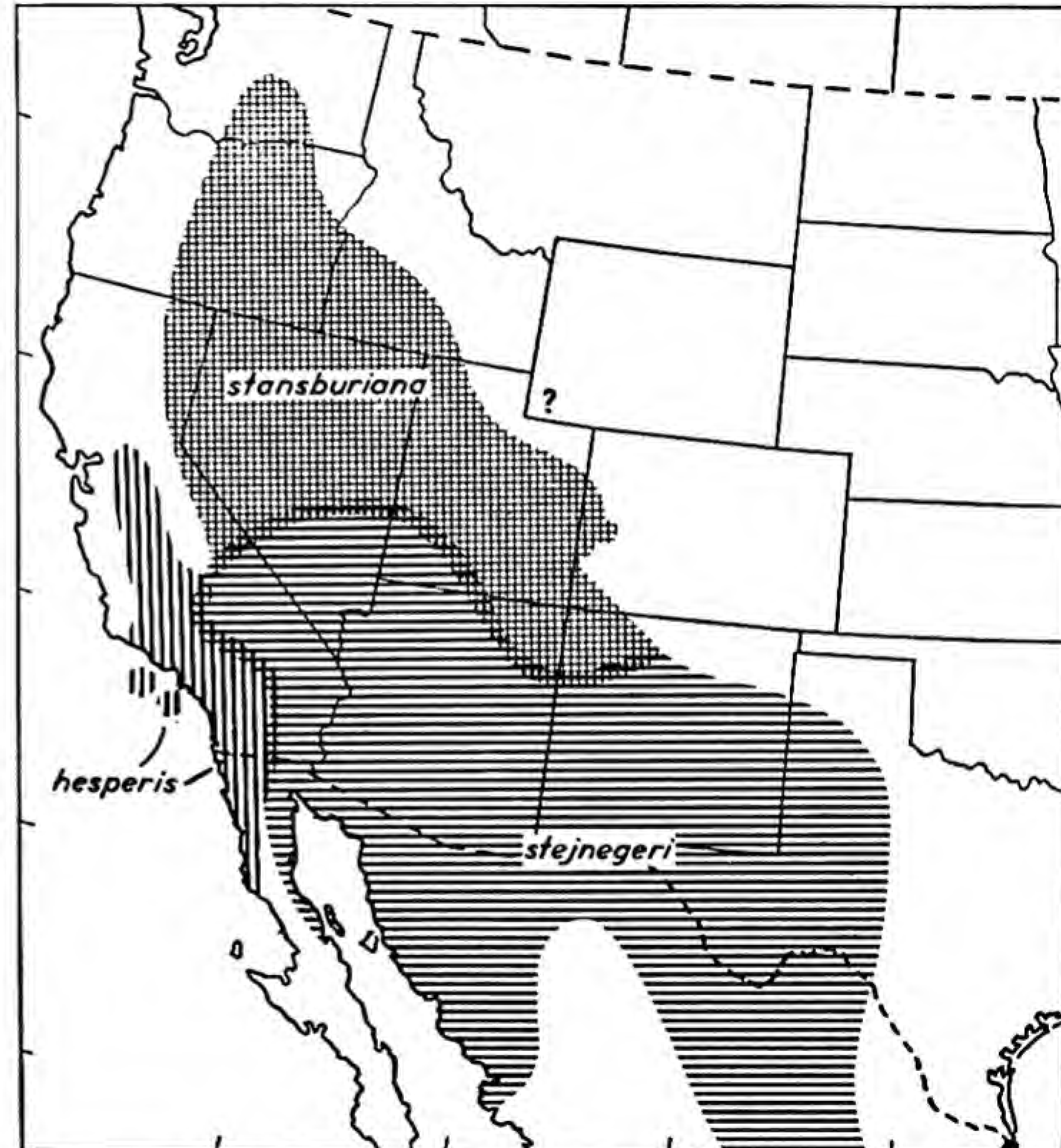
Map 16. Distribution of the subspecies of *Sceloporus graciosus.*



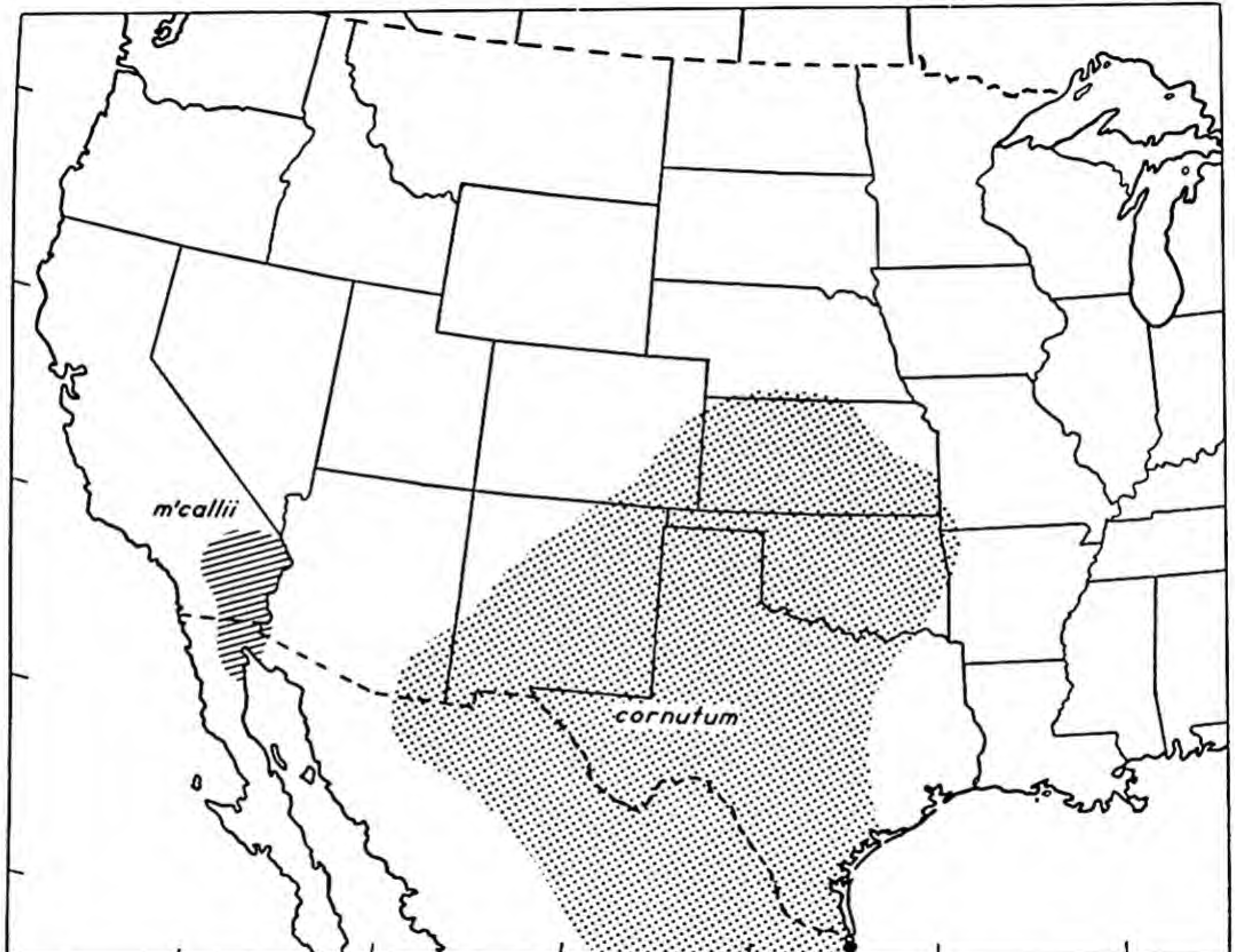
Map 17. Distribution of *Urosaurus graciosus* and *U. microscutatus.*



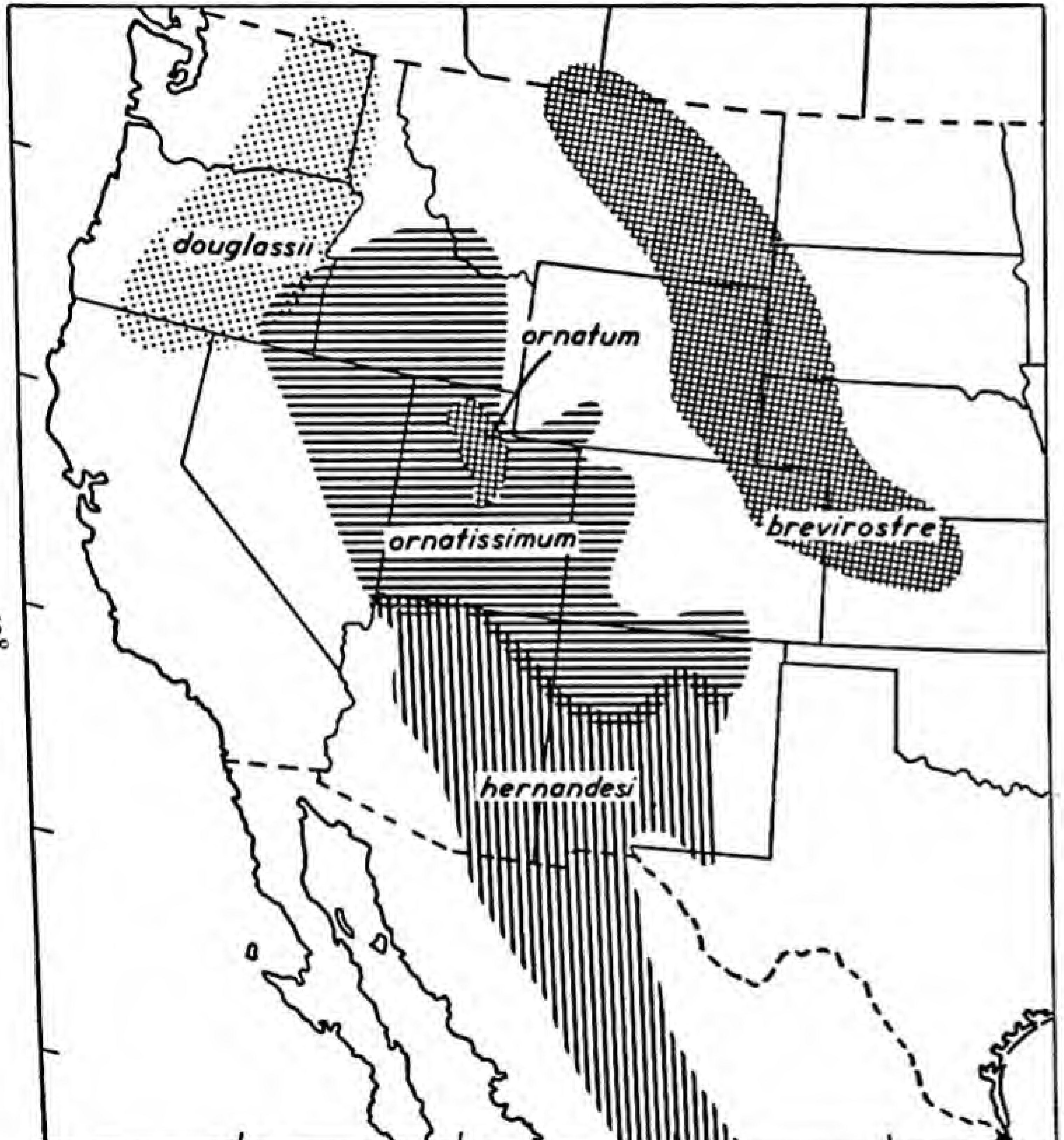
Map 18. Distribution of the subspecies of *Urosaurus ornatus.*



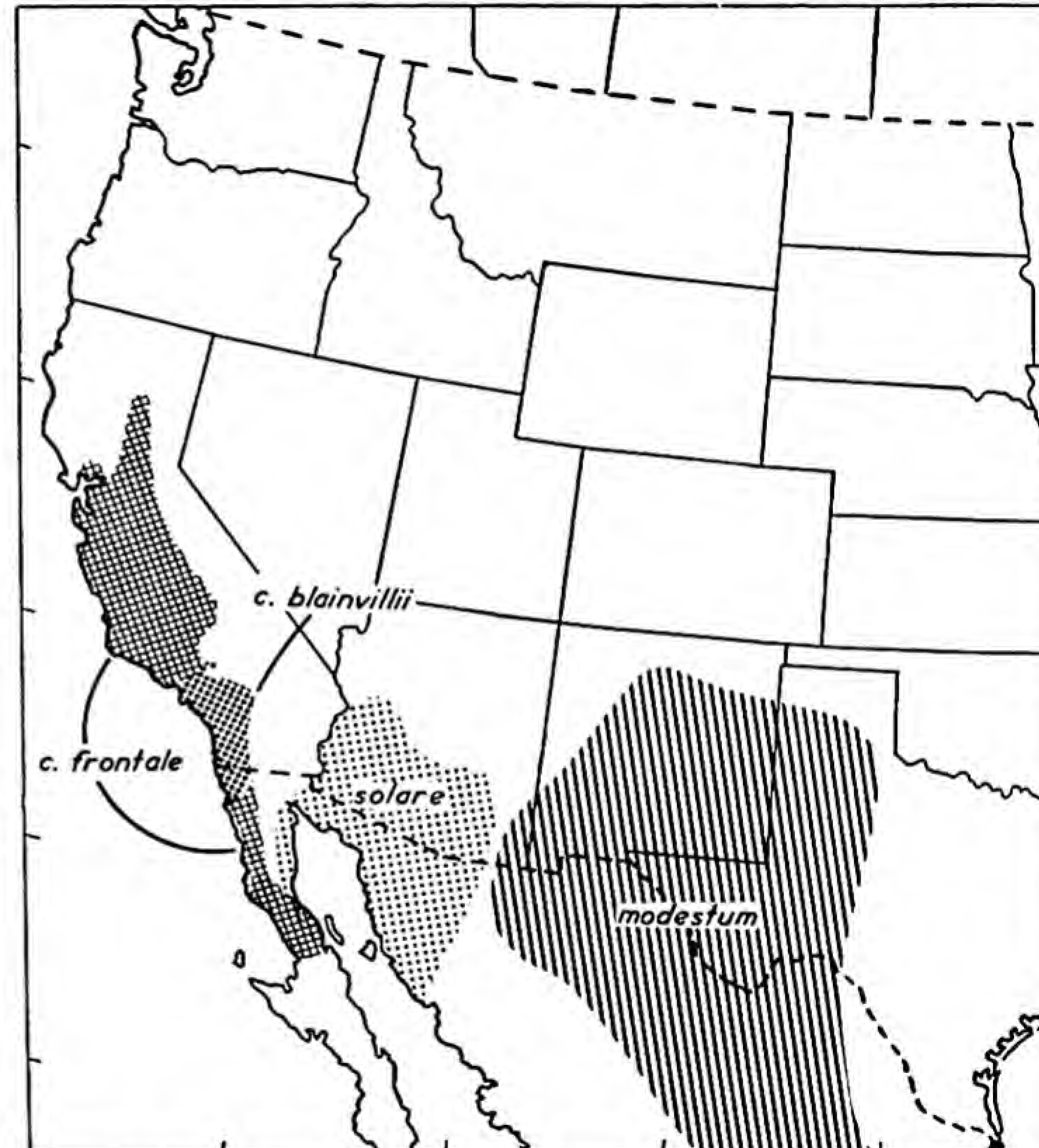
Map. 19. Distribution of the subspecies of *Uta stansburiana.*



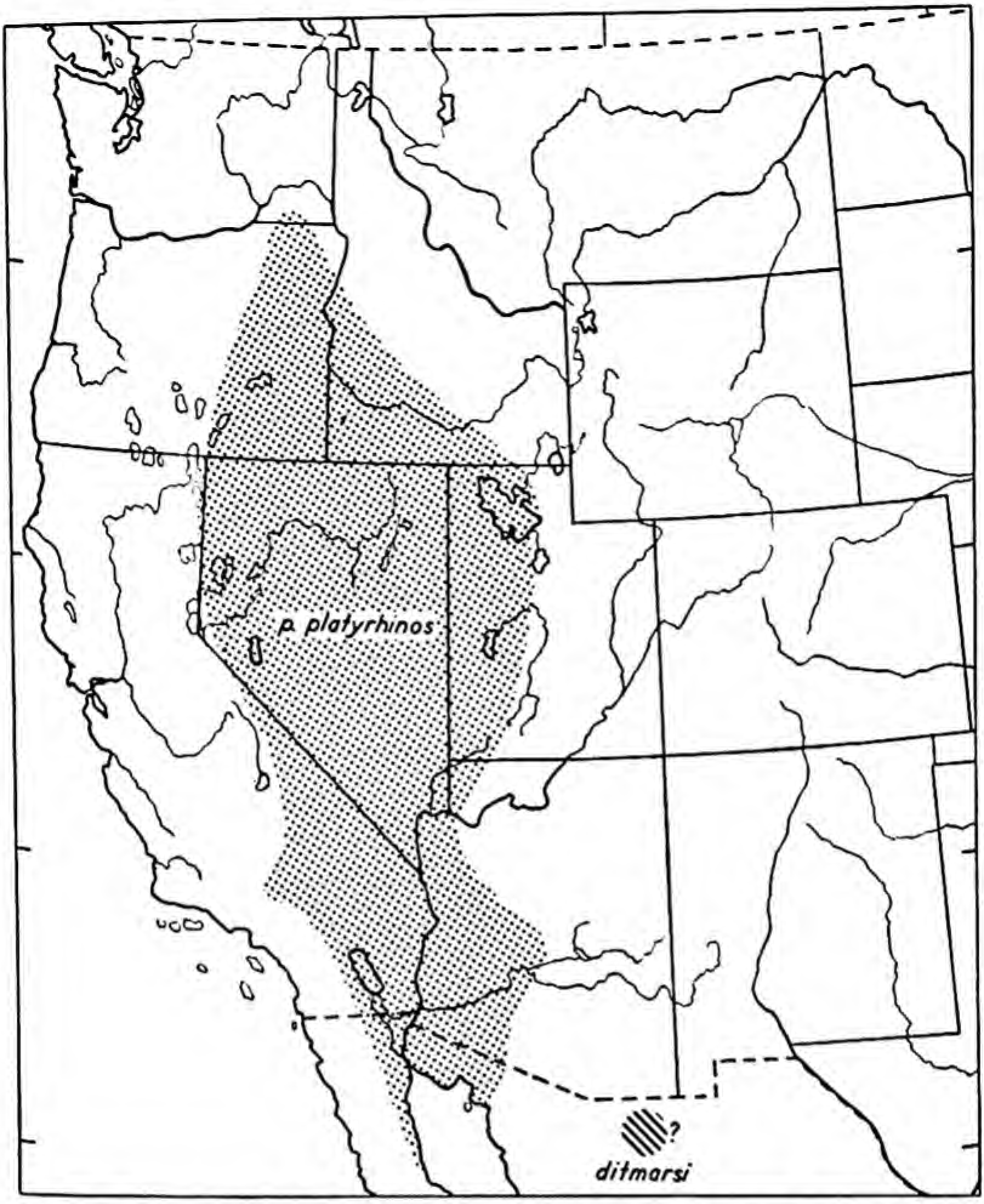
Map 20. Distribution of *Phrynosoma cornutum* and *P. m'callii.*



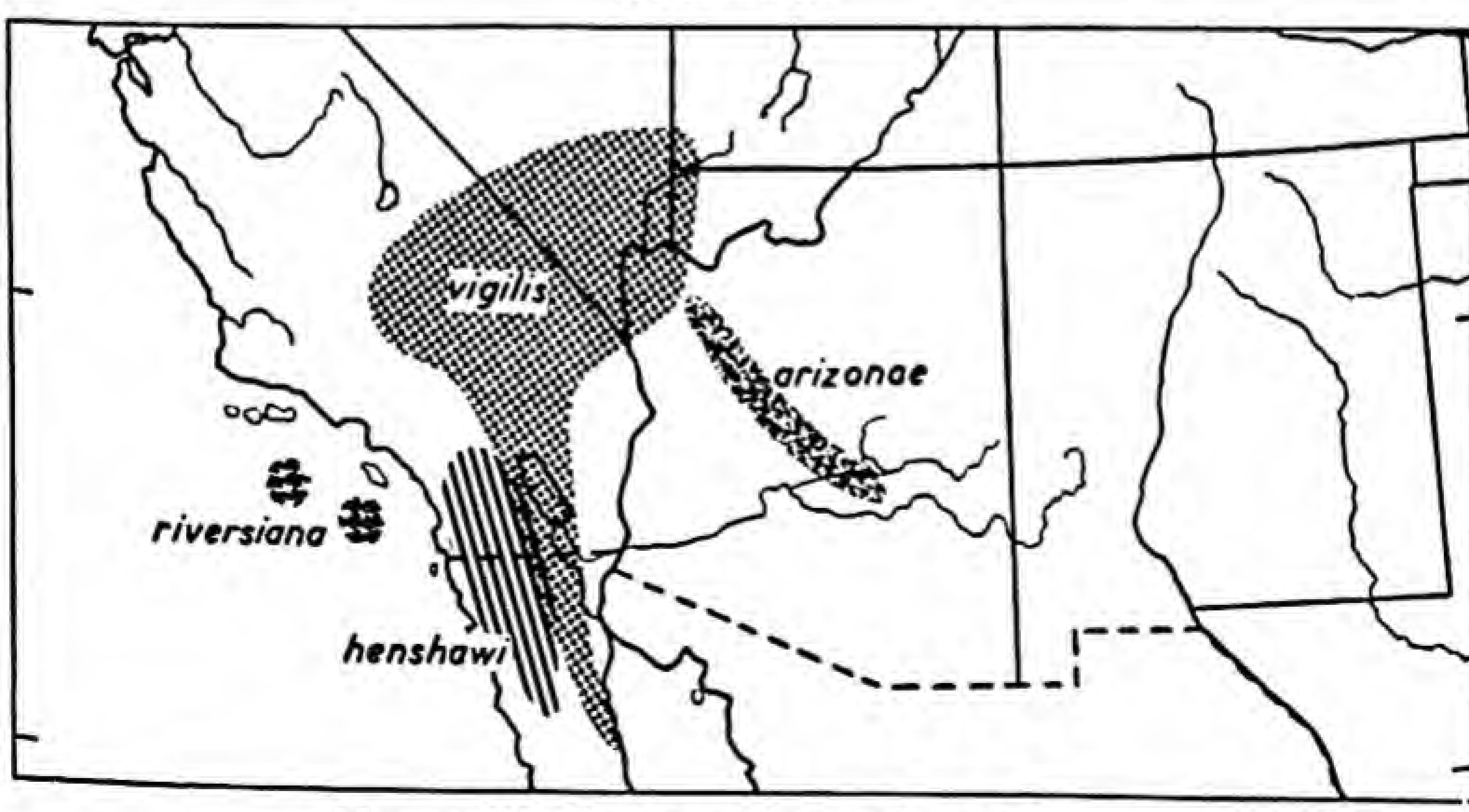
Map 21. Distribution of the subspecies of *Phrynosoma douglassii.*



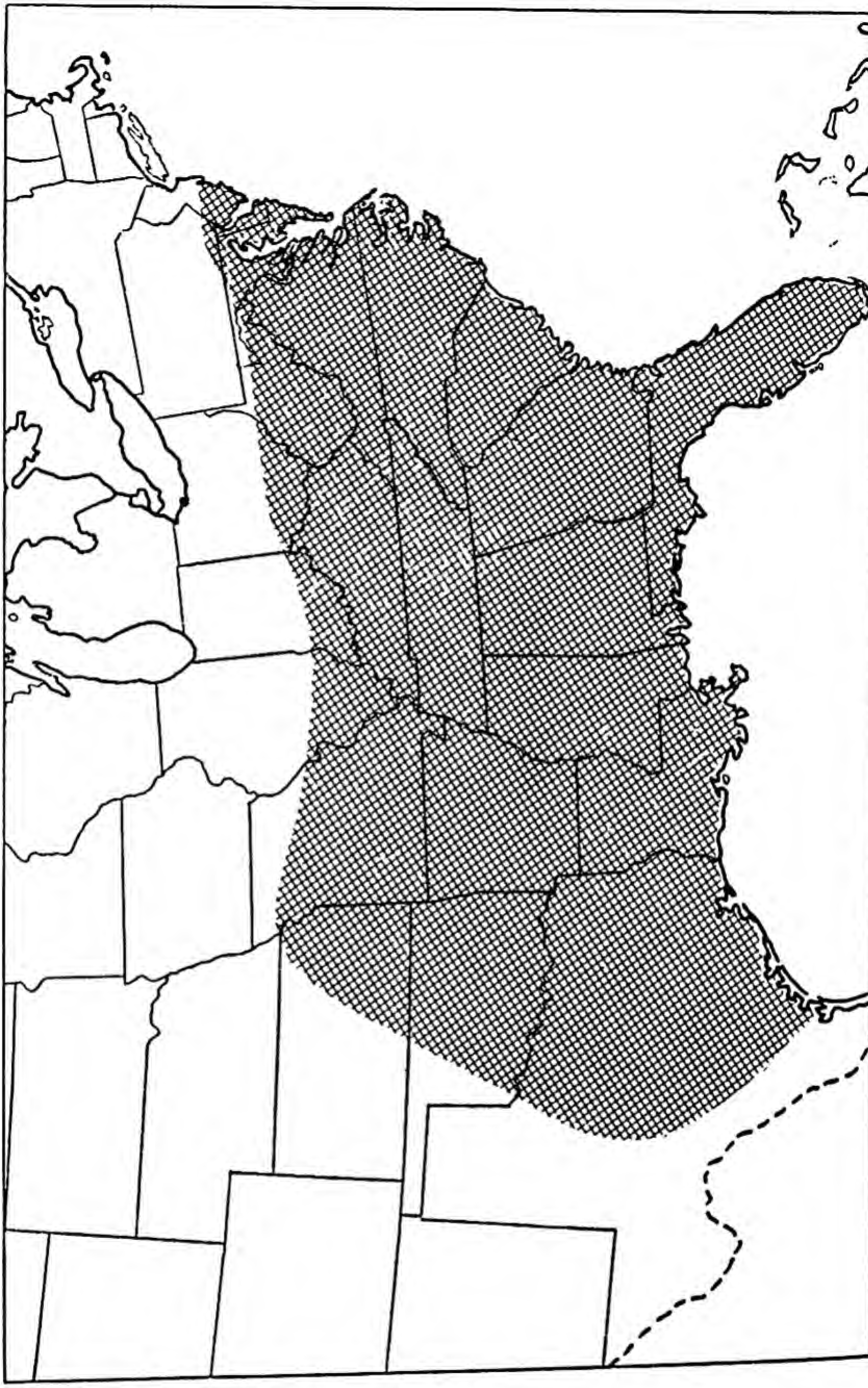
Map 22. Distribution of the subspecies of *Phrynosoma coronatum* and of *P. solare* and *P. modestum.*



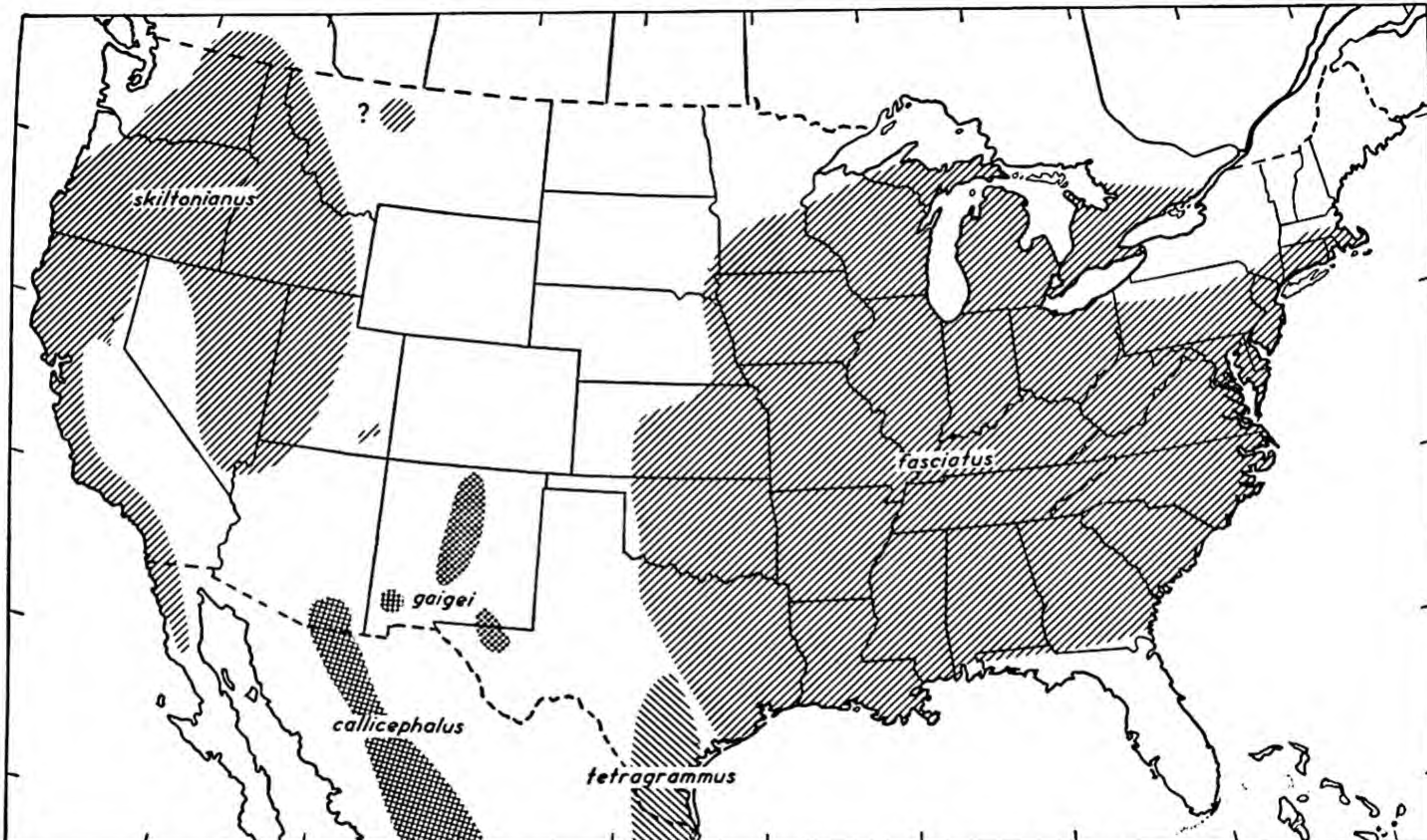
Map 23. Distribution of *Phrynosoma p. platyrhinos* and possible distribution of *P. ditmarsi.*



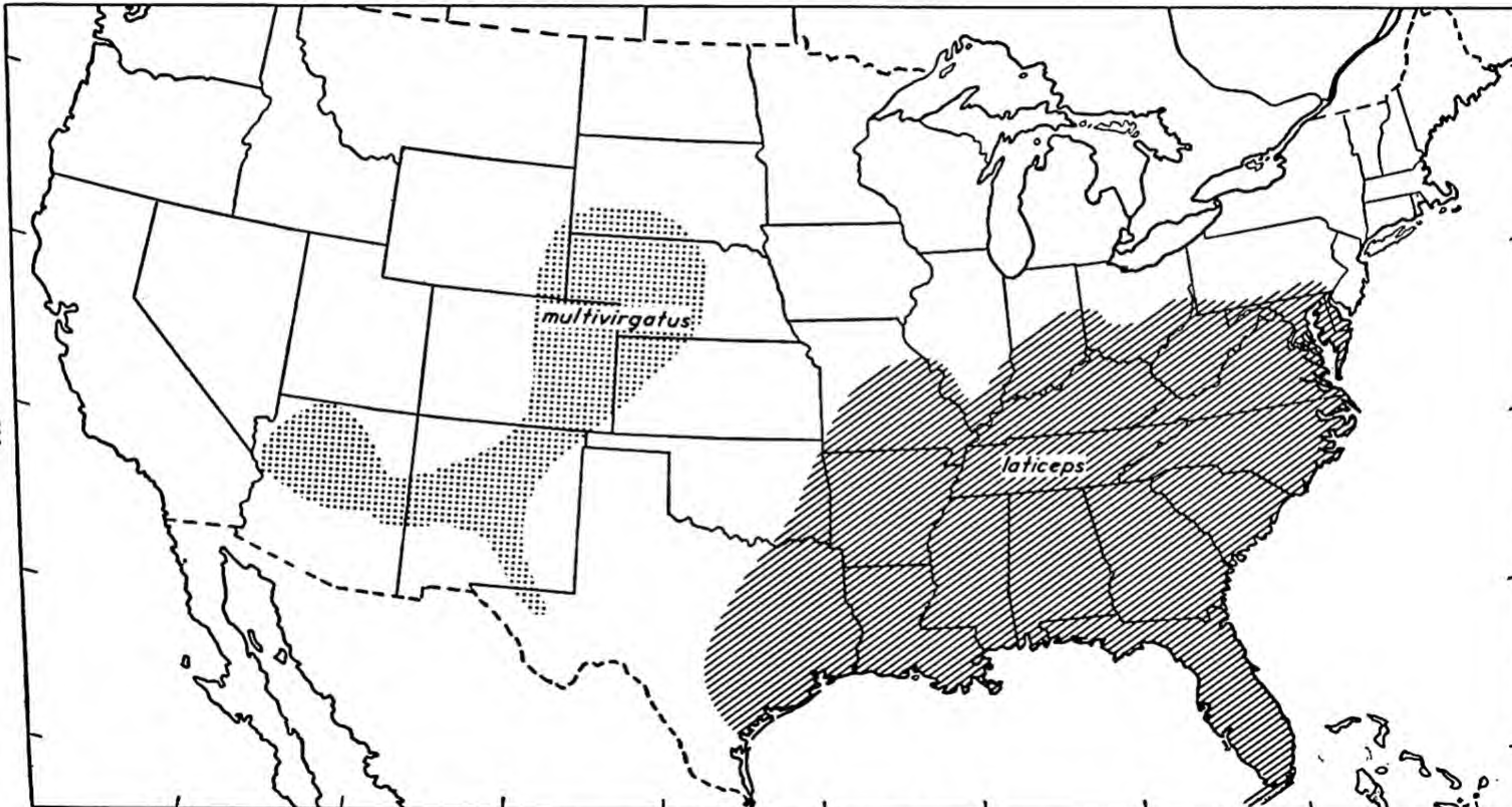
Map 24. Distribution of the species of *Xantusia.*



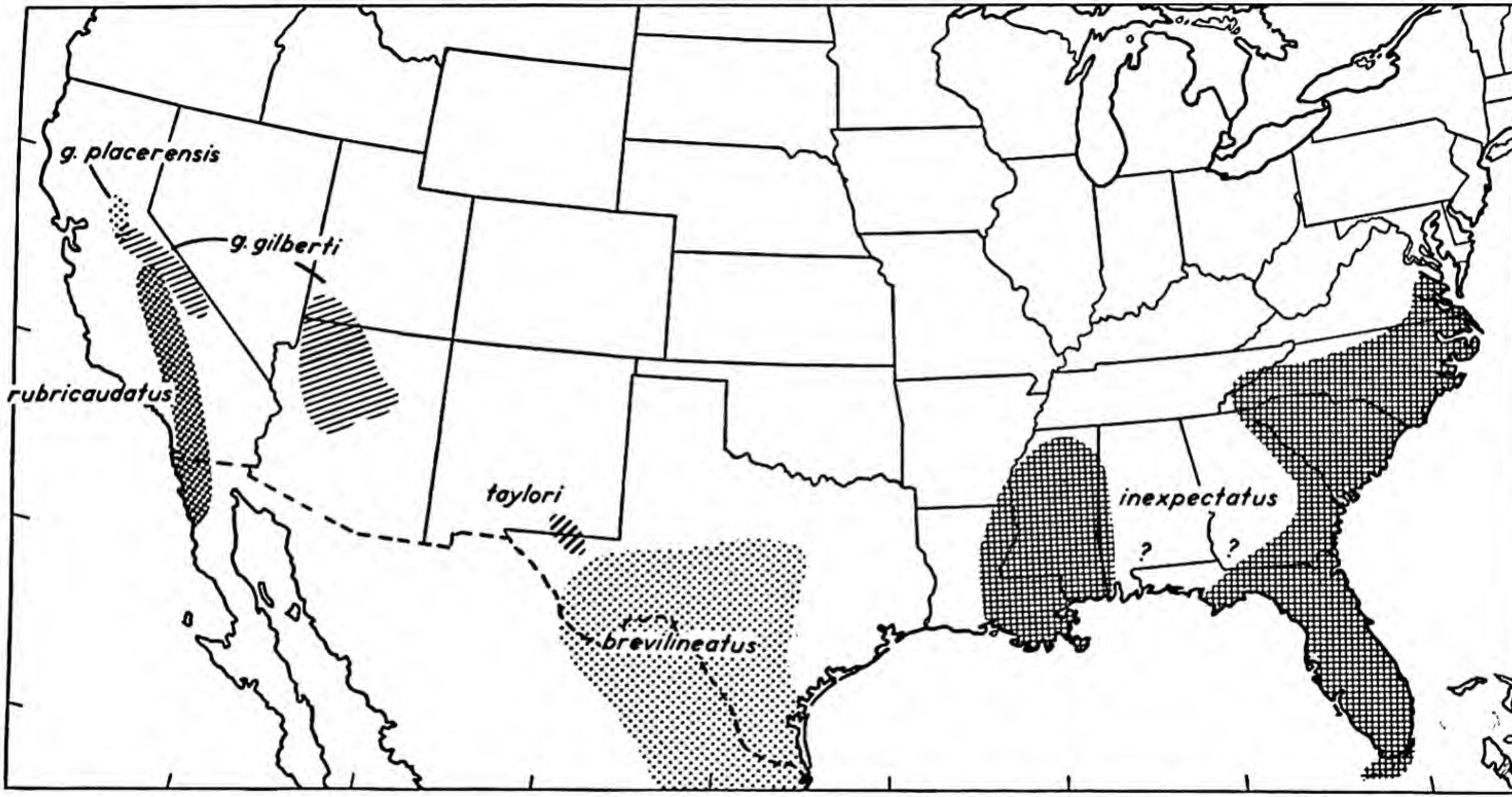
Map 25. Distribution of *Leiolopisma laterale*.



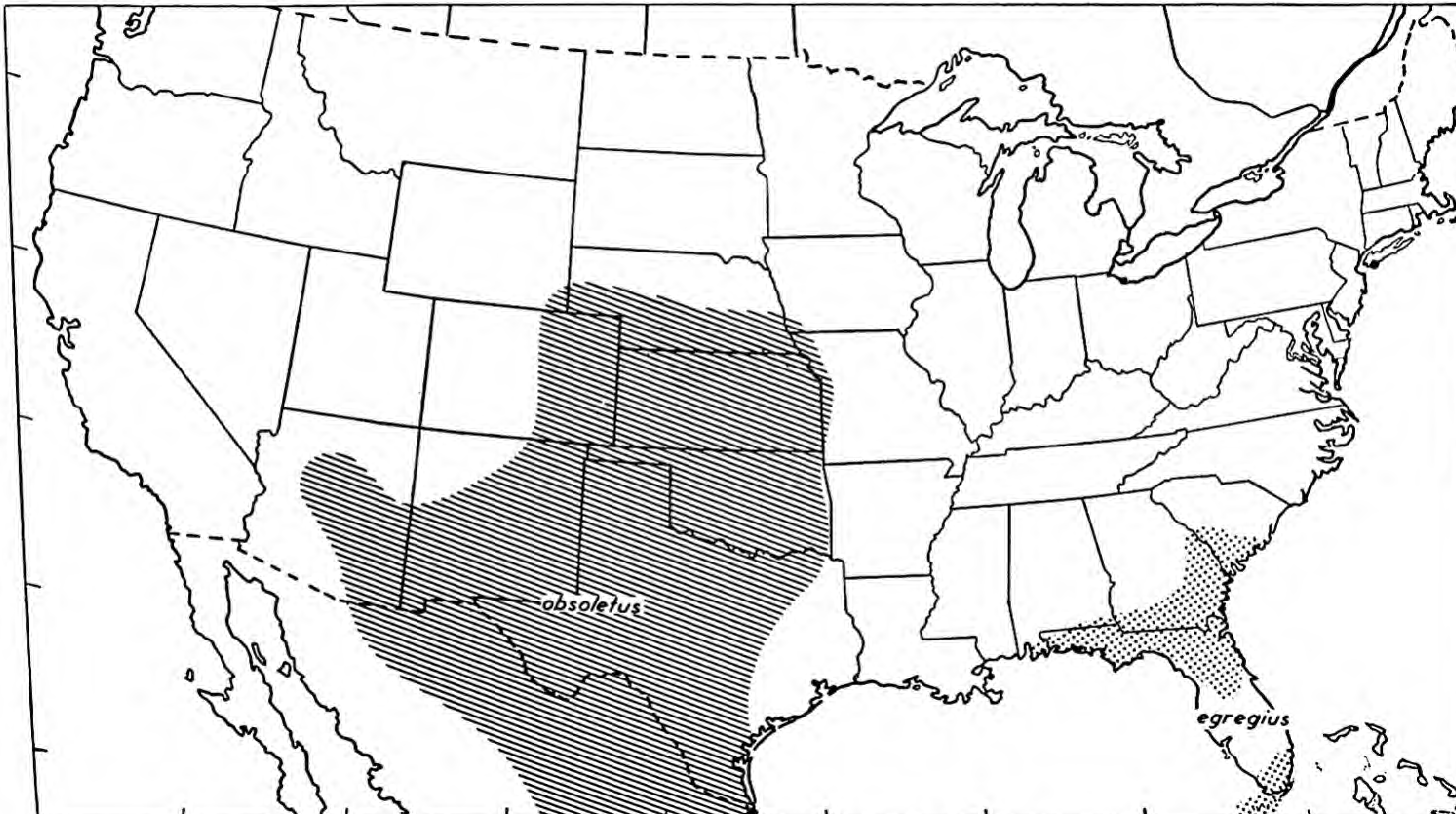
Map 26. Distribution of *Eumeces fasciatus, E. tetragrammus, E. gaigei, E. callicephalus,* and *E. skiltonianus.*



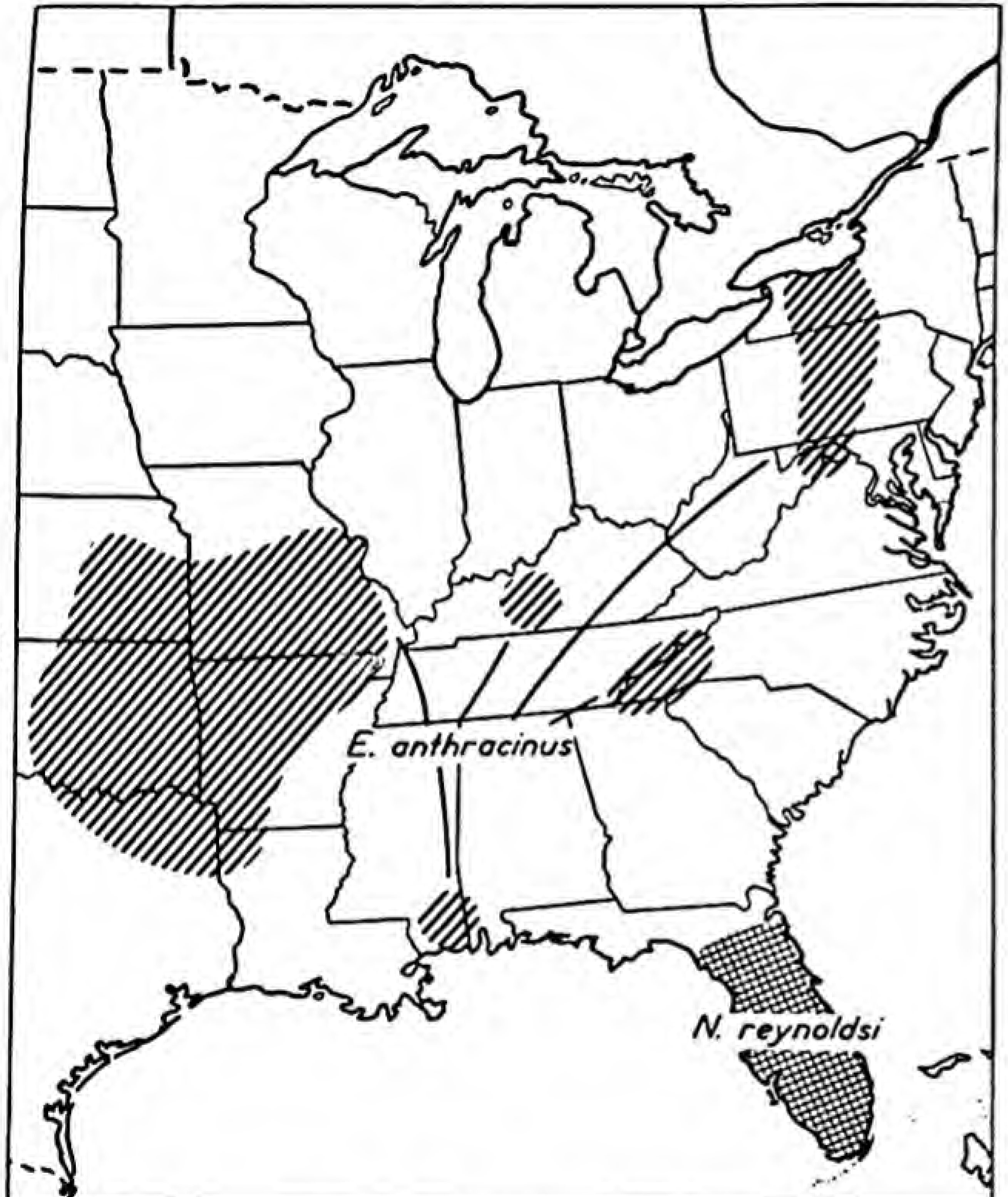
Map 27. Distribution of *Eumeces laticeps* and *E. multivirgatus*.



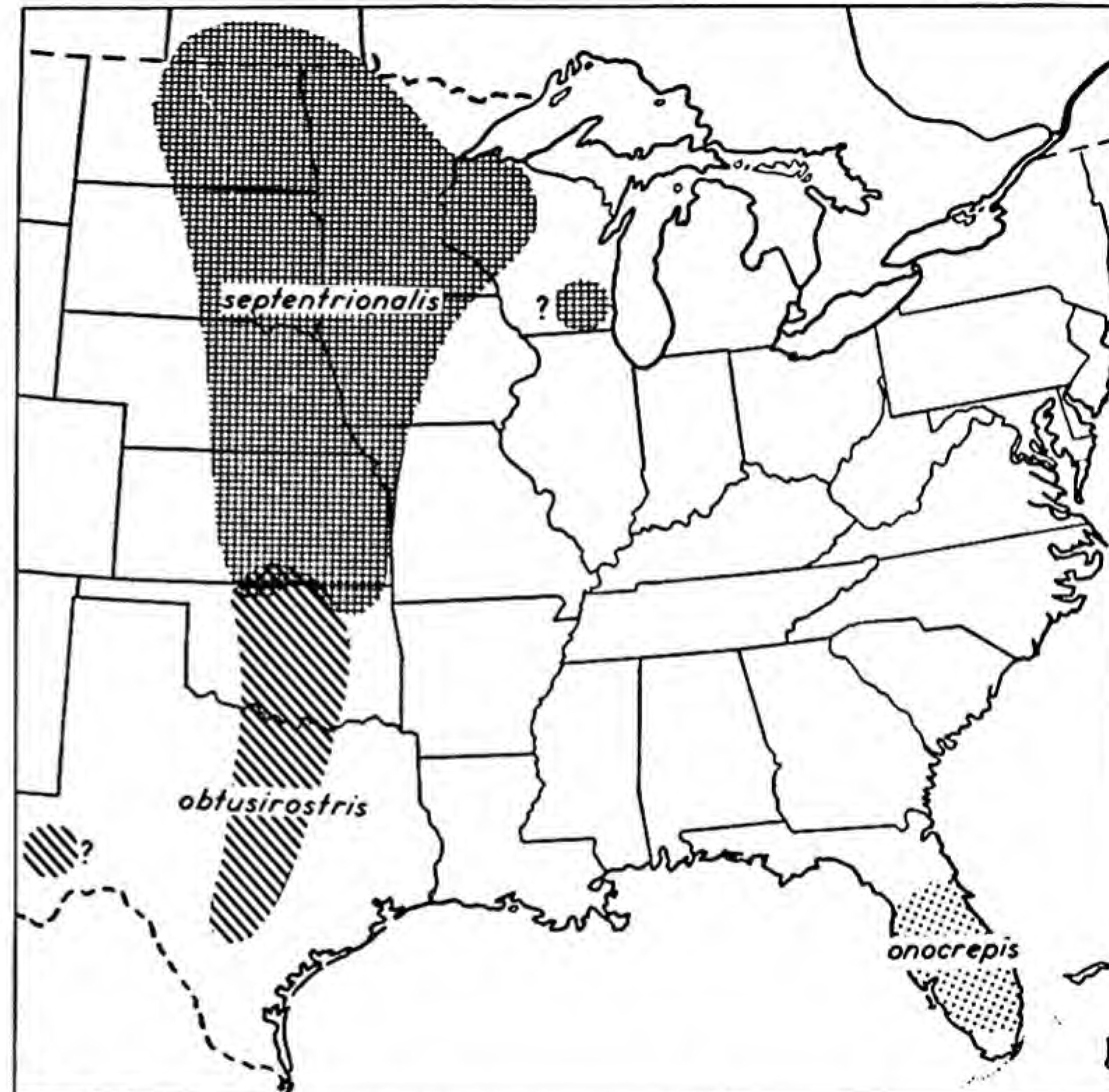
Map 28. Distribution of *Eumeces brevilineatus, E. g. gilberti, E. g. placerensis, E. inexpectatus, E. rubricaudatus,* and *E. taylori.*



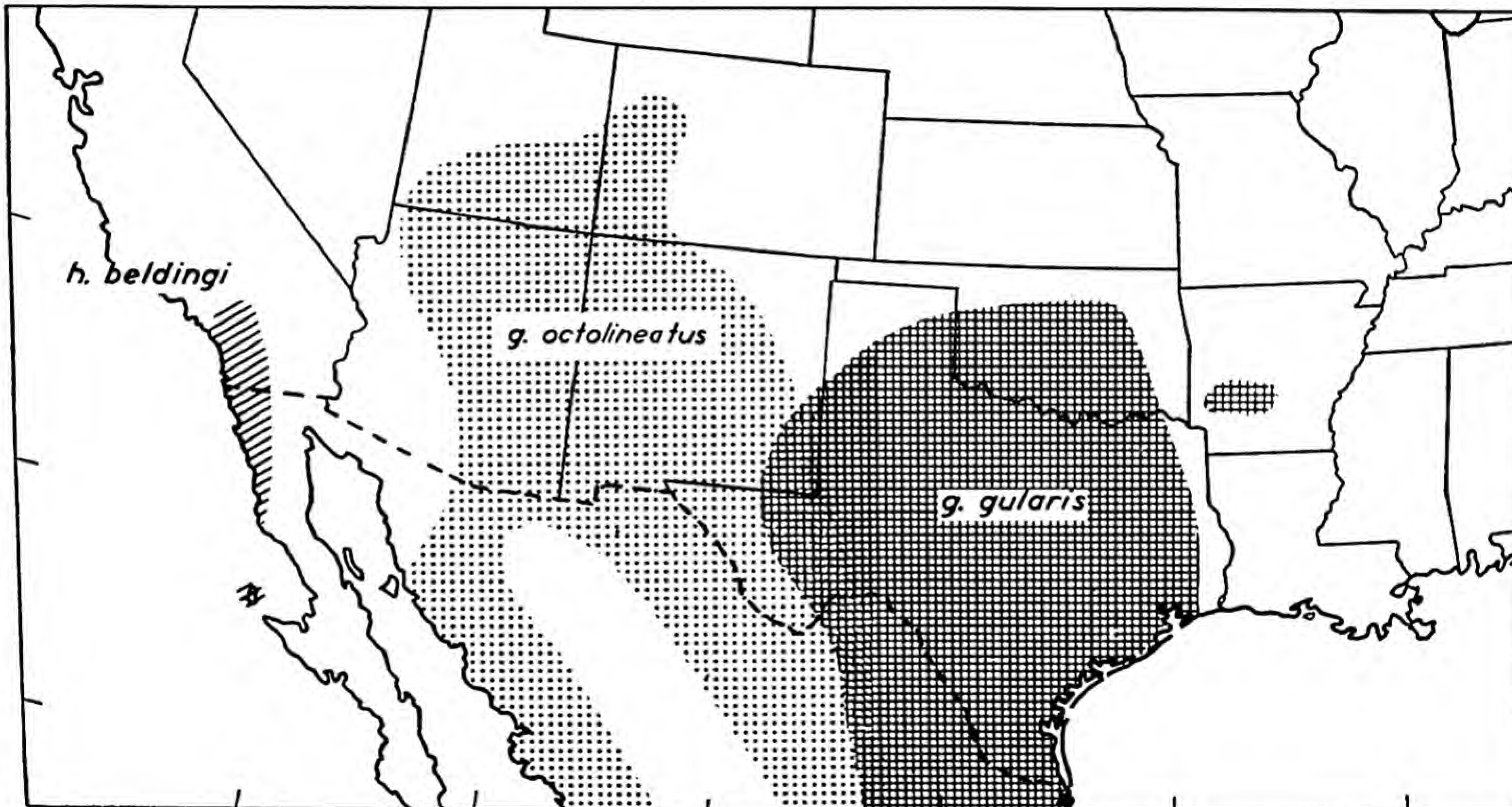
Map 29. Distribution of *Eumeces obsoletus* and *E. egregius*.



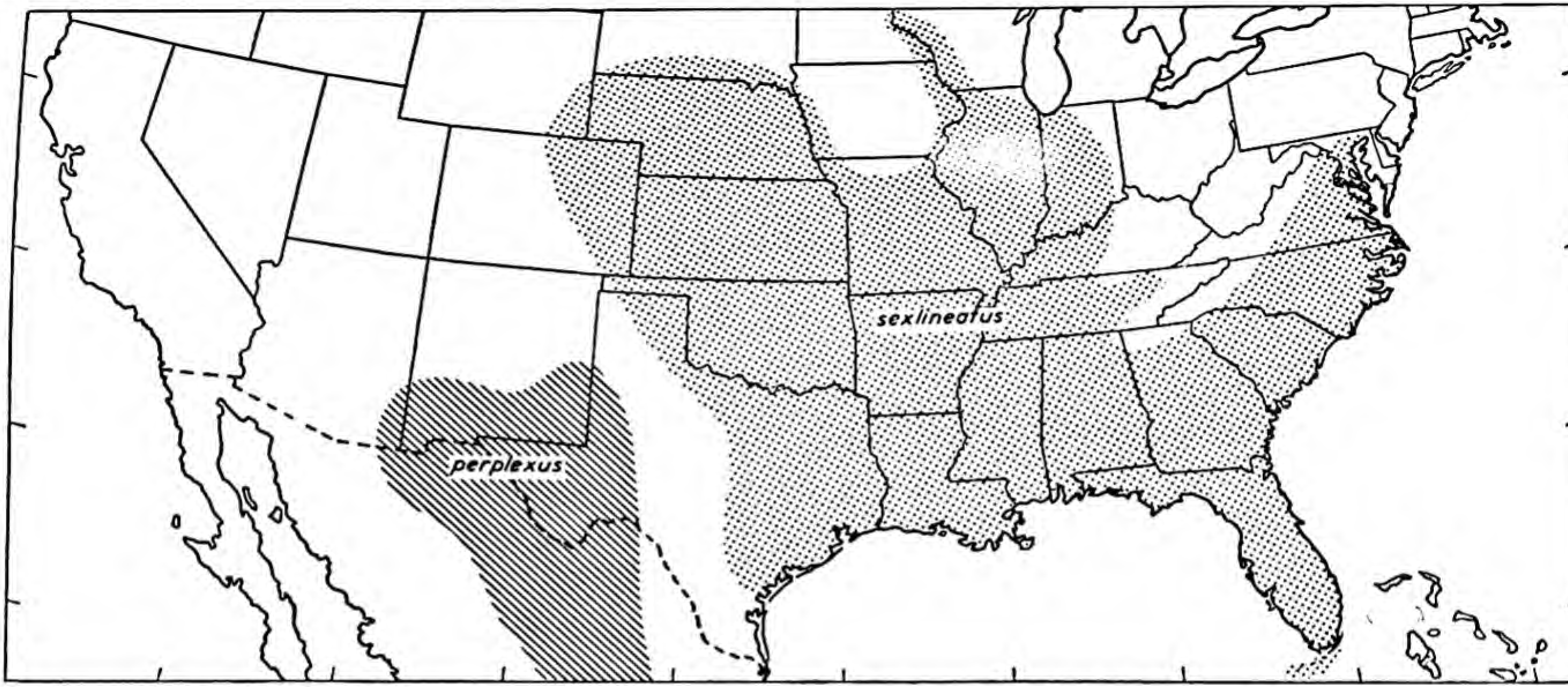
Map 30. Distribution of *Eumeces anthracinus* and *Neoseps reynoldsi*.



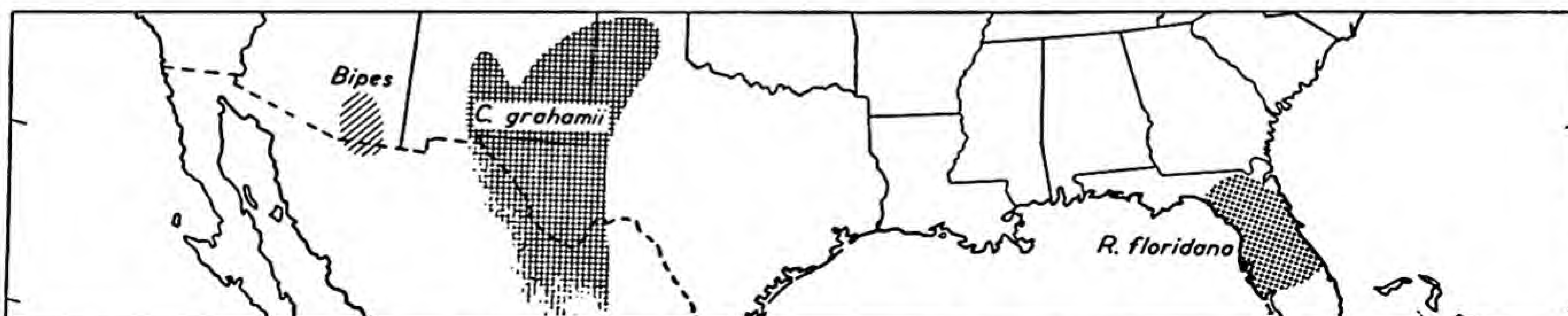
Map 31. Distribution of the subspecies of *Eumeces septentrionalis* and *E. onocrepis*.



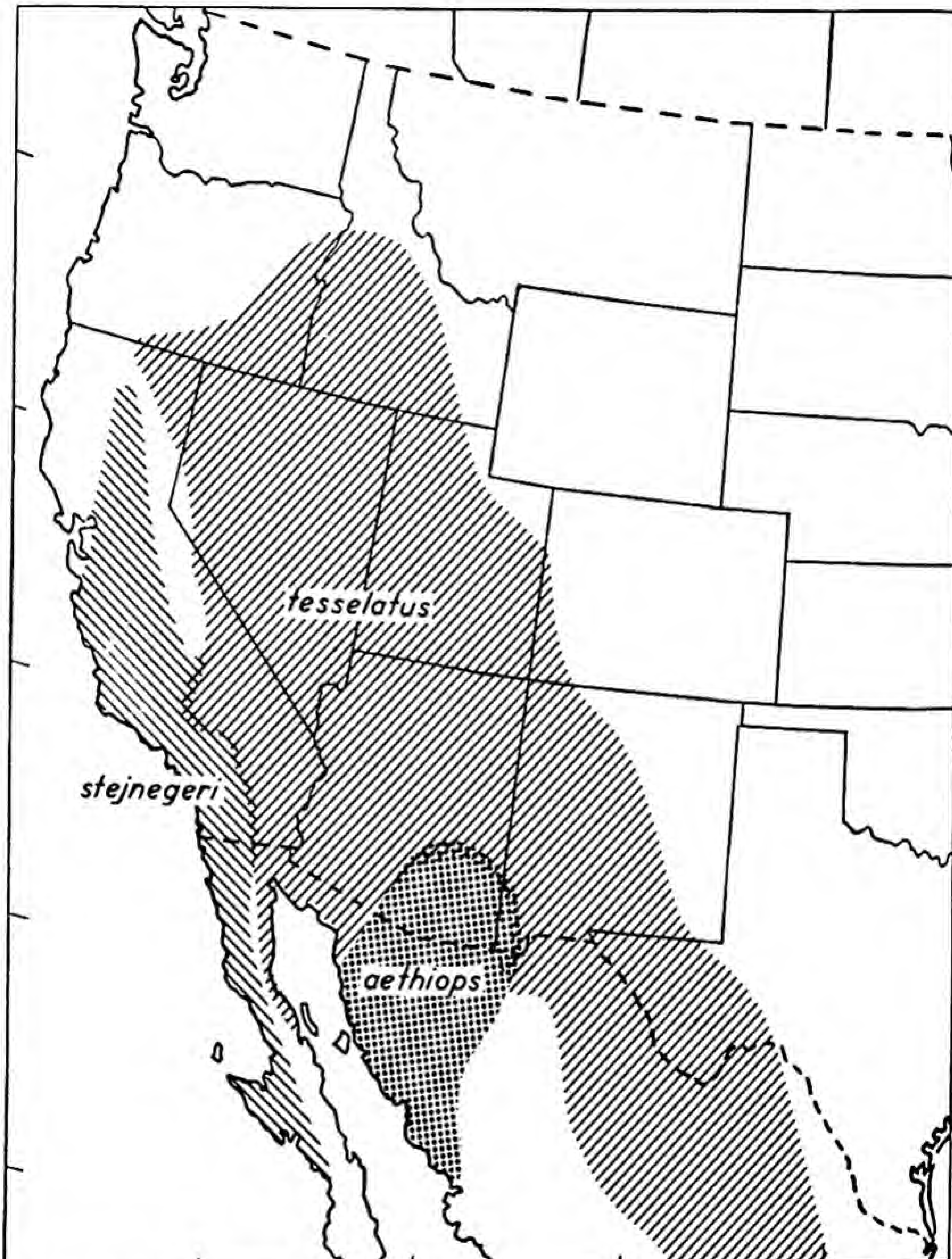
Map 32. Distribution of *Cnemidophorus hyperythrus beldingi*, *C. g. gularis*, and *C. g. octolineatus*.



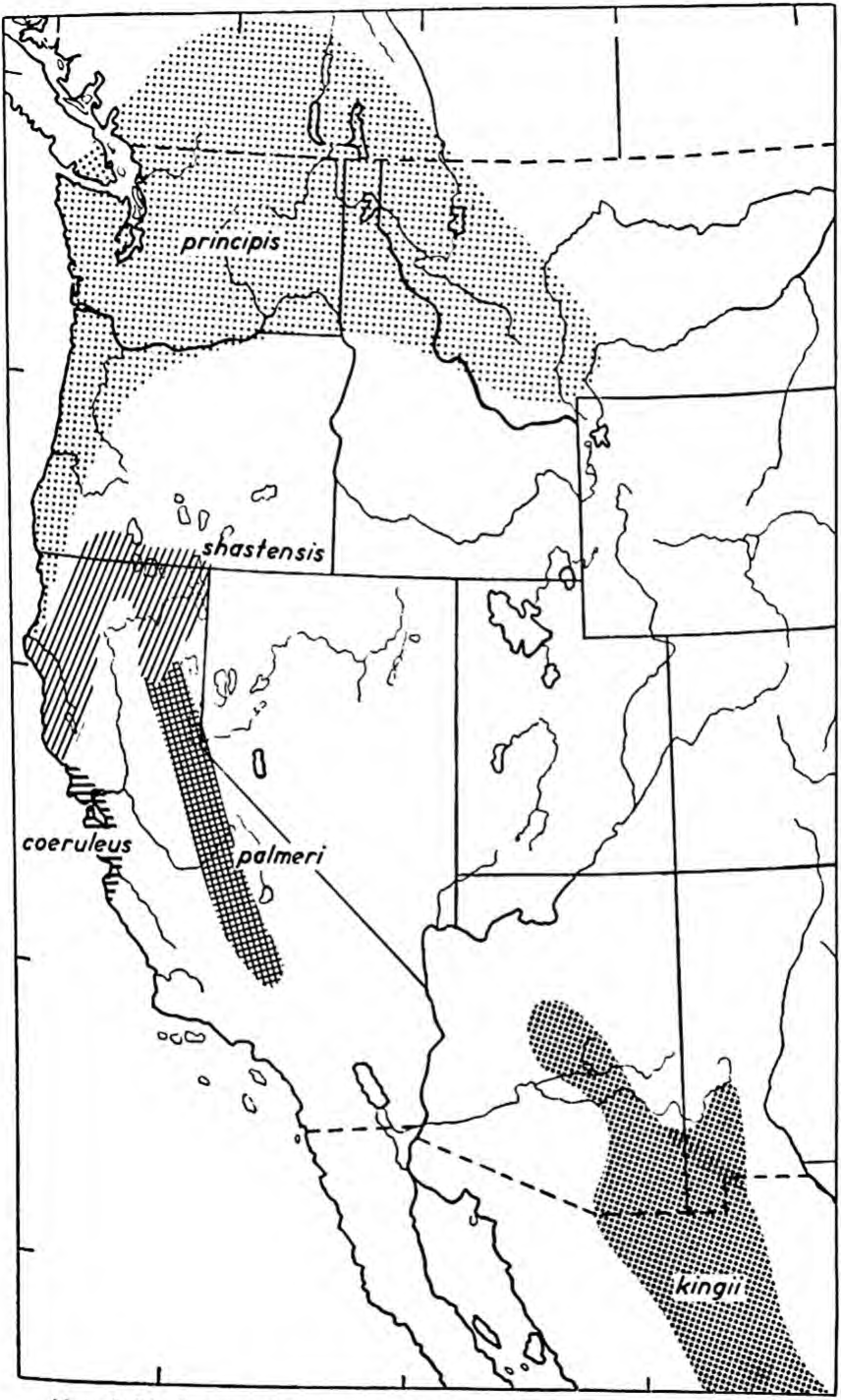
Map 33. Distribution of *Cnemidophorus perplexus* and *C. sexlineatus*



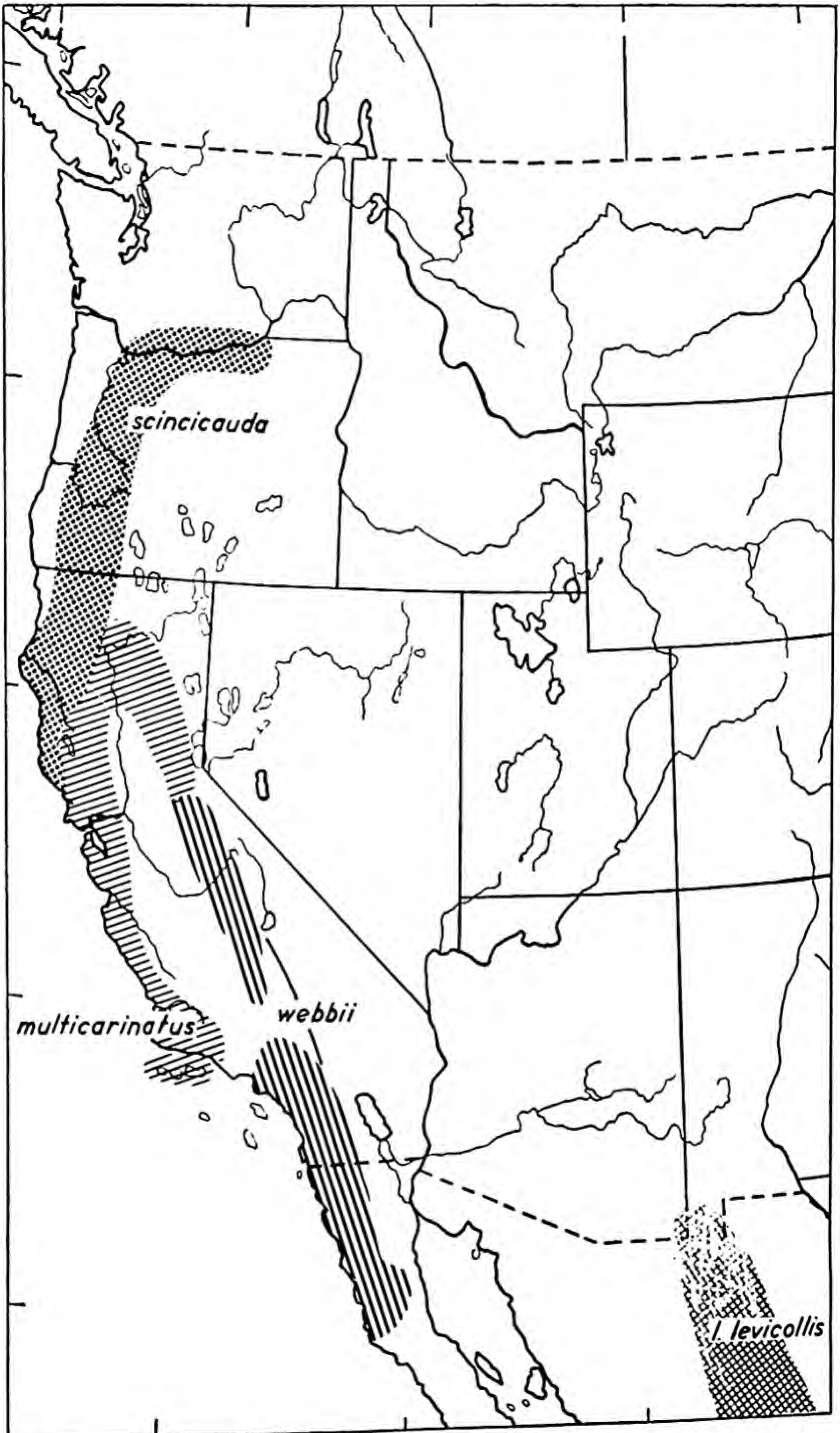
Map 34. Distribution of *Cnemidophorus grahamii*, *Rhineura floridana*, and the possible distribution of *Bipes*.



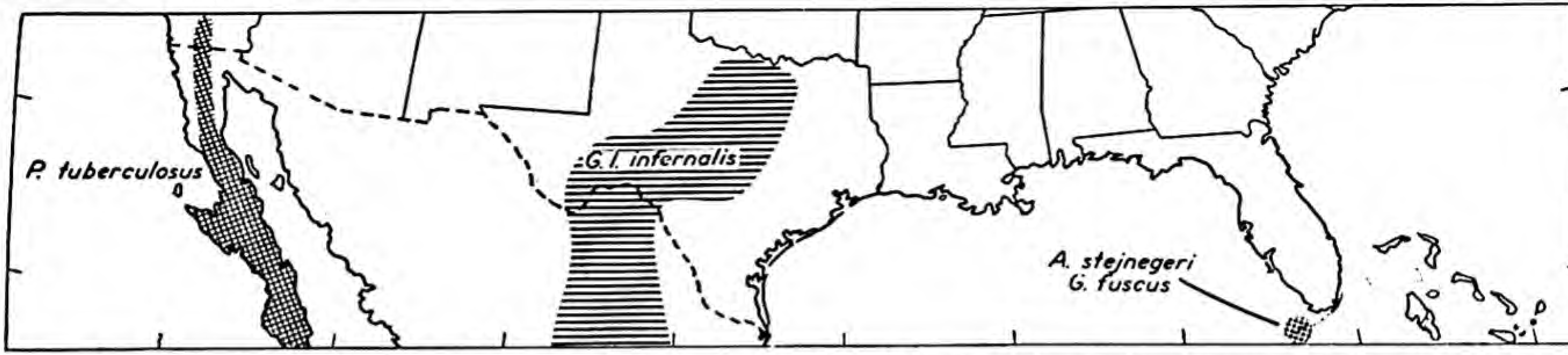
Map 35. Distribution of the subspecies of *Cnemidophorus tesselatus*.



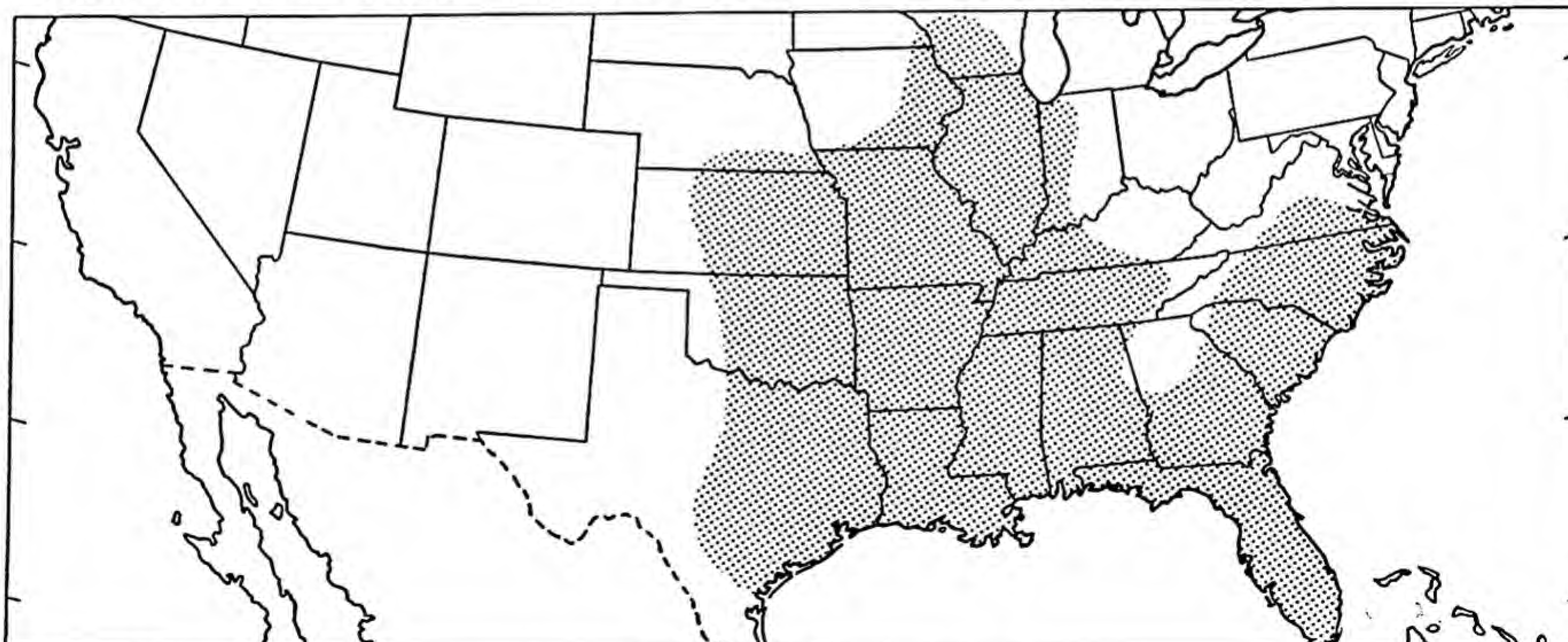
Map 36. Distribution of *Gerrhonotus kingii* and the subspecies of *G. coeruleus*.



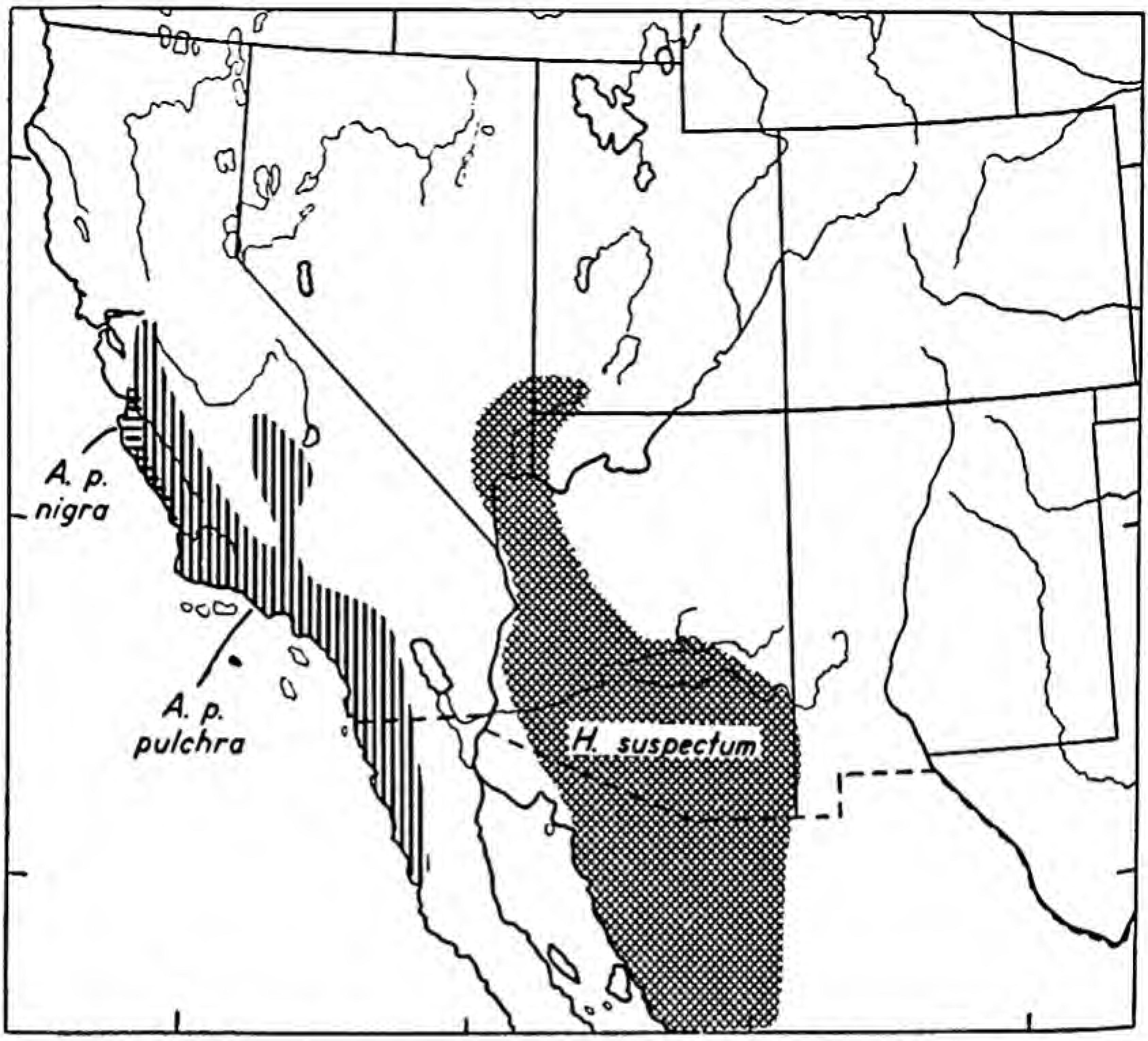
Map 37. Distribution of *Gerrhonotus l. levicollis* and the subspecies of *G. multicarinatus*.



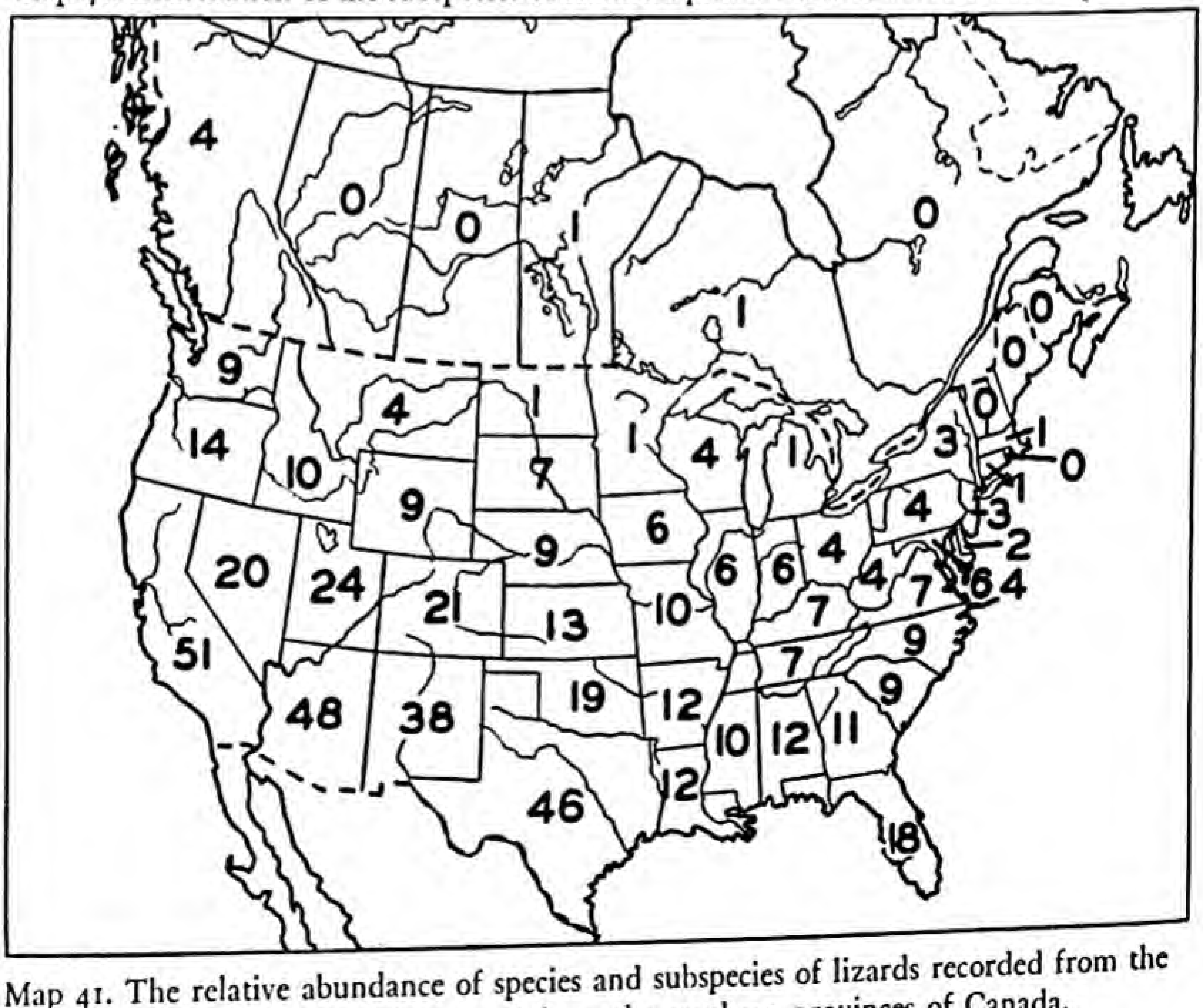
Map 38. Distribution of *Phyllodactylus tuberculosus*, *Gerrhonotus liocephalus infernalis*, *Anolis stejnegeri*, and *Gonatodes fuscus*.



Map. 39. Distribution of *Ophisaurus ventralis*.



Map 40. Distribution of the subspecies of *Anniella pulchra* and of *Heloderma suspectum*.



Map 41. The relative abundance of species and subspecies of lizards recorded from the states of the United States and from the southern provinces of Canada.

GENERAL LITERATURE

SOME of the more recent and useful papers of general importance are listed below. Only summaries of widely distributed natural groups and of large geographic areas are included.

Boulenger, E. A. 1885–1887. Catalogue of lizards in the British Museum (Natural History). 2d ed. London; British Museum (Nat. Hist.), vols. 1–3.

Burt, Charles E. 1928. The synonymy, variation and distribution of the collared lizard, *Crotaphytus collaris* (Say). Occ. Pap. Mus. Zool. Univ. Mich., no. 196, pp. 1–19, pls. 1–7.

——. 1931. A study of the teiid lizards of the genus *Cnemidophorus,* with special reference to their phylogenetic relationships. Bull. U.S. Nat. Mus., no. 154, pp. 1–286, figs. 1–38.

——. 1936. A key to the lizards of the United States and Canada. Trans. Kans. Acad. Sci., 38: 255–305, figs. 1–71.

Camp, Charles Lewis. 1923. Classification of the lizards. Bull. Amer. Mus. Nat. Hist., 48: 289–481, figs. 1–112.

Cope, E. D. 1900. The crocodilians, lizards and snakes of North America. Report U.S. Nat. Mus. for 1898, pp. 153–1270, pls. 1–36, text figs. 1–347.

Ditmars, Raymond L. 1936. The reptiles of North America. Garden City, N.Y.; Doubleday, Doran and Co., pp. i–xvi, 1–476, frontis., pls. 1–135.

Driver, Ernest C. 1942. Name that animal. Northampton, Mass., Kraushar Press, pp. 1–527, ill.

Fitch, Henry S. 1935. Natural history of the alligator lizards. Trans. St. Louis Acad. Sci., 29: 1–38, pls. 1–4.

——. 1938. A systematic account of the alligator lizards (*Gerrhonotus*) in the western United States and Lower California. Amer. Midl. Nat., 20: 381–424, figs. 1–5.

Gadow, Hans. 1923. Amphibia and reptiles. Cambridge Nat. Hist., 8: i–xiv, 1–668, figs. 1–181.

Gilmore, Charles W. 1928. Fossil lizards of North America. Mem. Nat. Acad. Sci., 22: i–x, 1–201, pls. 1–27, figs. 1–105.

Heifetz, William. 1941. A review of the lizards of the genus *Uma.* Copeia, no. 2, pp. 99–111, figs. 1–7.

Klauber, L. M. 1931. A new species of *Xantusia* from Arizona, with a synopsis of the genus. Trans. San Diego Soc. Nat. Hist., 7: 1–16, pl. 1, map.

Mittleman, M. B. 1942. A summary of the iguanid genus *Urosaurus*. *Bull. Mus.* Comp. Zool., 91: 103–181, pls. 1–16, figs. 1–11.

Pratt, Henry S. 1923. A manual of the land and fresh water vertebrate animals of the United States (exclusive of birds). Philadelphia, Blakiston's, pp. i–xv, 1–422, figs. 1–184, map.

Schmidt, K. P. 1921. New species of North American lizards of the genera *Holbrookia* and *Uta*. Amer. Mus. Nov., no. 22, pp. 1–6.

——. 1922. A review of the North American genus of lizards *Holbrookia*. Bull. Amer. Mus. Nat. Hist., no. 46, pp. 709–725, pls. 58–60, text figs. 1–5.

Smith, H. M. 1933. On the relationships of the lizards *Coleonyx brevis* and *Coleonyx variegatus*. Trans. Kans. Acad. Sci., 36: 301–314, 1 pl., 1 fig.

——. 1938. The lizards of the *torquatus* group of the genus *Sceloporus* Wiegmann, 1828. Univ. Kans. Sci. Bull., 37: 539–693, pls. 47–55, figs. 1–25.

——. 1938. Remarks on the status of the subspecies of *Sceloporus undulatus*, with descriptions of new species and subspecies of the *undulatus* group. Occ. Pap. Mus. Zool. Univ. Mich., no. 387, pp. 1–17, tables 1–2, map.

——. 1939. The Mexican and Central American lizards of the genus *Sceloporus*. Zool. Ser. Field Mus. Nat. Hist., 26: 1–397, pls. 1–31, figs. 1–59.

Stejneger, Leonhard, and Thomas Barbour. 1943. A check list of North American amphibians and reptiles. 5th ed. Cambridge, Harvard Univ. Press, pp. i–xx, 1–260.

Taylor, E. H. 1936. A taxonomic study of the cosmopolitan scincoid lizards of the genus *Eumeces*, with an account of the distribution and relationships of the species. Univ. Kans. Sci. Bull., 23: pp. 1–643, pls. 1–43, figs. 1–84.

Van Denburgh, John. 1922. The reptiles of western North America. Vol. I. Lizards Occ. Pap. Calif. Acad. Sci., 10: 1–611, pls. 1–57.

STATE LISTS OF SPECIES AND LITERATURE

Certain species may be shown by the maps to occur in states for which they are not listed below. In such cases locality records in adjacent states furnish sufficient evidence of their occurrence to justify inclusion of the questionable area in the range. Since only definite records have been utilized in constructing the following lists, additions to a number may be expected.

As a general rule imported species, even those native to other parts of the country, are not included in the lists; certain exceptions, indicated by an asterisk, are made in the case of United States species that are dubious (for instance collared lizards and horned lizards in Louisiana), or extralimital species that give indication of becoming established. Thus geckos are listed for all states from which they have been recorded, because of their notorious ability to establish themselves in seaports. *Leiocephalus* is perhaps dubious but is included. On the other hand the permanence of the colony of *Lacerta* in Pennsylvania is less assured. Other species, notably *Phrynosoma cornutum*, that have been distributed widely over the United States by the intercession of man, are not listed for the areas in which they may have thus become artificially established. To include them assumes permanence of colonization that only eons can prove. The cases of artificial distribution that are accepted are clearly introductions and do not obscure ideas of normal distribution.

Map 41 (p. 512) summarizes the numbers of forms known from the political provinces of Canada and the United States.

ALABAMA: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus sexlineatus
3. Eumeces anthracinus
4. Eumeces egregius
5. Eumeces fasciatus
6. Eumeces inexpectatus
7. Eumeces laticeps
8. Leiolopisma laterale
9. Ophisaurus ventralis
10. Sceloporus undulatus hyacinthinus
11. Sceloporus undulatus undulatus
*12. Sphaerodactylus notatus

References:

Burt, C. E. 1939. The lizards of the southeastern United States. Trans. Kans. Acad. Sci., 40: 349–366.

Haltom, William L. 1931. Alabama reptiles. Ala. Mus. Nat. Hist. Paper, no. 11, pp. i–vi, 1–145, pls. 1–39, figs. 1-56.

Kauffeld, Carl F. 1941. The red-tailed skink, *Eumeces egregius*, in Alabama. Copeia, no. 1, p. 51.

Löding, H. P. 1922. A preliminary catalogue of Alabama amphibians and reptiles. Ala. Mus. Nat. Hist. Paper, no. 5, pp. 1–59.

ARIZONA: *Species Recorded*

1. Callisaurus draconoides gabbii
2. Callisaurus draconoides ventralis
3. Cnemidophorus gularis octolineatus
4. Cnemidophorus perplexus
5. Cnemidophorus tesselatus aethiops
6. Cnemidophorus tesselatus tesselatus
7. Coleonyx variegatus
8. Crotaphytus collaris baileyi
9. Dipsosaurus dorsalis dorsalis
10. Eumeces callicephalus
11. Eumeces gilberti gilberti
12. Eumeces multivirgatus
13. Eumeces obsoletus
14. Gambelia wislizenii wislizenii
15. Gerrhonotus kingii
16. Heloderma suspectum
17. Holbrookia maculata approximans
18. Holbrookia maculata pulchra
19. Holbrookia maculata thermophila
20. Holbrookia texana
21. Phrynosoma cornutum
22. Phrynosoma douglassii hernandesi
23. Phrynosoma douglassii ornatissimum
24. Phrynosoma m'callii
25. Phrynosoma modestum
26. Phrynosoma platyrhinos platyrhinos
27. Phrynosoma solare
28. Sauromalus obesus
29. Sceloporus clarkii clarkii
30. Sceloporus graciosus graciosus
31. Sceloporus jarrovii jarrovii
32. Sceloporus magister magister
33. Sceloporus poinsettii
34. Sceloporus scalaris slevini
35. Sceloporus undulatus consobrinus
36. Sceloporus undulatus elongatus
37. Sceloporus undulatus tristichus
38. Sceloporus undulatus virgatus
39. Uma notata notata
40. Urosaurus graciosus
41. Urosaurus ornatus chiricahuae
42. Urosaurus ornatus linearis
43. Urosaurus ornatus symmetricus
44. Urosaurus ornatus wrighti
45. Uta stansburiana stansburiana
46. Uta stansburiana stejnegeri
47. Xantusia arizonae
48. Xantusia vigilis

References:

Burt, Charles E. 1933. Some lizards from the Great Basin of the West and adjacent areas, with comments on the status of various forms. Amer. Midl. Nat., 13: 228–250.

——, and M. D. Burt. 1929. Field notes and locality records on a collection of amphibians and reptiles, chiefly from the western half of the United States. II. Reptiles. Journ. Wash. Acad. Sci., 19: 448–460.

Cowles, R. B., and C. M. Bogert, 1936. The herpetology of the Boulder Dam region (Nev., Ariz., Utah). Herpetologica, 1: 33–42.

Dodge, Natt N. 1938. Amphibians and reptiles of Grand Canyon National Park. Bull. Grand Canyon Nat. Hist. Assoc., no. 9, pp. 1–55, ill.

Eaton, Theodore H. 1935. Amphibians and reptiles of the Navajo country. Copeia, no. 3, pp. 150–151.

——. 1935. Report on amphibians and reptiles of the Navajo country. Bull. Rainbow Bridge Monument Valley Exped., no. 3, pp. 1–18.

Gloyd, Howard K. 1937. The Chicago Academy of Sciences Arizona expedition April–June, 1937. Progr. Act. Chicago Acad. Sci., 6 (2): 3–26, figs. 1–14.
——. 1937. A herpetological consideration of faunal areas in southern Arizona. Bull. Chicago Acad. Sci., 5: 79–136, figs. 1–21.
Kauffeld, Carl F. 1943. Field notes on some Arizona reptiles and amphibians. Amer. Midl. Nat., 29: 342–359, pls. 1–2, figs. 1–2.
King, F. Willis. 1932. Herpetological records and notes from the vicinity of Tucson, Arizona, July and August, 1930. Copeia, no. 4, pp. 175–177.
Klauber, L. M. 1939. Studies of reptile life in the arid Southwest. Bull. Zool. Soc. San Diego, no. 14, pp. 1–100, tables 1–15, map.
Little, Elbert L., Jr. 1940. Amphibians and reptiles of the Roosevelt Reservoir area, Arizona. Copeia, no. 4, pp. 260–265.
MacCoy, Clinton V. 1932. Herpetological notes from Tucson, Arizona. Occ. Pap. Bost. Soc. Nat. Hist., 8: 11–24.
McKee, Edwin D., and Charles M. Bogert. 1934. The amphibians and reptiles of Grand Canyon National Park. Copeia, no. 4, pp. 178–180.
Ortenburger, A. I. 1926. Field observations on some amphibians and reptiles of Pima County, Arizona. Proc. Okla. Acad. Sci., 6: 101–121.
Quaintance, Charles W. 1935. Reptiles and amphibians from Eagle Creek, Greenlee County, Arizona. Copeia, no. 4, pp. 183–185.
Ruthven, A. G. 1907. A collection of reptiles and amphibians from southern New Mexico and Arizona. Bull. Amer. Mus. Nat. Hist., 23: 483–604, figs. 1–22.
Springer, Stewart. 1928. An annotated list of the lizards of Lee's Ferry, Arizona Copeia, no. 169, pp. 100–104.
Taylor, E. H. 1938. Does the amphisbaenid genus *Bipes* occur in the United States? Copeia, no. 4, p. 202.
Van Denburgh, John. 1896. A list of some reptiles from southeastern Arizona, with a description of a new species of *Cnemidophorus*. Proc. Calif. Acad. Sci., 2d ser., 6: 338–349.
——, and Joseph R. Slevin. 1913. A list of the amphibians and reptiles of Arizona, with notes on the species in the collection of the academy. Proc. Calif. Acad. Sci., 4th ser., 3: 391–454, pls. 17–28.

ARKANSAS: *Species Reported*

1. Anolis carolinensis
2. Cnemidophorus gularis gularis
3. Cnemidophorus sexlineatus
4. Crotaphytus collaris collaris
5. Eumeces anthracinus
6. Eumeces fasciatus
7. Eumeces laticeps
8. Leiolopisma laterale
9. Ophisaurus ventralis
10. Phrynosoma cornutum
11. Sceloporus undulatus consobrinus
12. Sceloporus undulatus hyacinthinus

References:

Black, John D., and S. C. Dellinger. 1938. Herpetology of Arkansas. Part II. The amphibians. Occ. Pap. Univ. Ark. Mus., no. 2, pp. 1–30.
Dellinger, S. C., and J. D. Black. 1938. Herpetology of Arkansas. Part I. The reptiles. Occ. Pap. Univ. Ark. Mus., no. 1, pp. 1–47.

Hurter, Julius, and John K. Strecker, 1909. The amphibians and reptiles of Arkansas. Trans. St. Louis Acad. Sci., 18: 11–27.
Schwardt, H. H. 1938. Reptiles of Arkansas. Bull. Univ. Ark. Agr. Exp. Sta., no. 357, pp. 1–47.

CALIFORNIA: *Species Recorded*

1. Anniella pulchra nigra
2. Anniella pulchra pulchra
3. Callisaurus draconoides gabbii
4. Cnemidophorus hyperythyrus beldingi
5. Cnemidophorus tesselatus stejnegeri
6. Cnemidophorus tesselatus tesselatus
7. Coleonyx variegatus
8. Crotaphytus collaris baileyi
9. Dipsosaurus dorsalis dorsalis
10. Eumeces gilberti gilberti
11. Eumeces gilberti placerensis
12. Eumeces rubricaudatus
13. Eumeces skiltonianus
14. Gambelia wislizenii silus
15. Gambelia wislizenii wislizenii
16. Gerrhonotus coeruleus coeruleus
17. Gerrhonotus coeruleus palmeri
18. Gerrhonotus coeruleus principis
19. Gerrhonotus coeruleus shastensis
20. Gerrhonotus multicarinatus multicarinatus
21. Gerrhonotus multicarinatus scincicauda
22. Gerrhonotus multicarinatus webbii
23. Phrynosoma coronatum blainvillii
24. Phrynosoma coronatum frontale
25. Phrynosoma douglassii douglassii
26. Phrynosoma m'callii
27. Phrynosoma platyrhinos platyrhinos
28. Phyllodactylus tuberculosus
29. Sauromalus obesus
30. Sceloporus graciosus gracilis
31. Sceloporus graciosus graciosus
32. Sceloporus graciosus vandenburgianus
33. Sceloporus magister magister
34. Sceloporus occidentalis becki
35. Sceloporus occidentalis biseriatus
36. Sceloporus occidentalis occidentalis
37. Sceloporus occidentalis taylori
38. Sceloporus orcutti
39. Streptosaurus mearnsi
40. Uma inornata
41. Uma notata notata
42. Uma scoparia
43. Urosaurus graciosus
44. Urosaurus microscutatus
45. Urosaurus ornatus symmetricus
46. Uta stansburiana hesperis
47. Uta stansburiana stansburiana
48. Uta stansburiana stejnegeri
49. Xantusia henshawi
50. Xantusia riversiana
51. Xantusia vigilis

References:

Bogert, C. M. 1930. An annotated list of the amphibians and reptiles of Los Angeles County, California. Bull. Southern Calif. Acad. Sci., 29: 3–14, map.
Bryant, Harold C. 1911. The horned lizards of California and Nevada of the genera *Phrynosoma* and *Anota*. Univ. Calif. Publ. Zool., 9: 1–84, pls. 1–9.
Camp, Charles Lewis. 1916. The subspecies of *Sceloporus occidentalis* with description of a new form from the Sierra Nevada and systematic notes on other California lizards. Univ. Calif. Publ. Zool., 17: 63–74.

——. 1916. Notes on the local distribution and habits of the amphibians and reptiles of southeastern California in the vicinity of the Turtle Mountains. Univ. Calif. Publ. Zool., 17: 503–544.

Cowles, R. B. 1944. Parturition in the yucca night lizard. Copeia, no. 2, pp. 98–100, fig. 1.

Fitch, Henry S. 1939. Desert reptiles in Lassen Co., California. Herpetologica, 1: 151–152.

Grinnell, Joseph. 1908. The biota of the San Bernardino Mountains. Univ. Calif. Publ. Zool., 5: 1–170, pls. 1–24.

——, and Charles Lewis Camp. 1917. A distributional list of the amphibians and reptiles of California. Univ. Calif. Publ. Zool., 17: 127–208, 14 text figs.

——, Joseph Dixon, and Jean M. Linsdale. 1930. Vertebrate natural history of a section of northern California through the Lassen Peak region. Univ. Calif. Publ. Zool., 35: i–v, 1–594, figs. 1–181.

——, and Hilda Wood Grinnell. 1907. Reptiles of Los Angeles County, California. Throop Inst. Bull., 35: 1–64, figs. 1–2.

——, and Jean M. Linsdale. 1936. Vertebrate animals of Point Lobos Reserve, 1934–35. Carn. Inst. Wash. Publ., no. 481, pp. 1–vi, 1–159, pls. 1–39.

——, and Tracy I. Storer. 1921. Reptiles and amphibians of Yosemite National Park. In, Handbook of Yosemite National Park, comp. and ed. Ansel F. Hall. New York: Putnam's, pp. 175–182.

——. 1924. Animal life of the Yosemite. Berkeley, Calif., Univ. Calif. Press, pp. i–xviii, 1–752, pls. i–ix, figs. 1–65.

Klauber, L. M. 1932. Amphibians and reptiles observed enroute to Hoover Dam. Copeia, no. 3, pp. 118–128.

——. 1934. Annotated list of the amphibians and reptiles of the southern border of California. Bull. Zool. Soc. San Diego, no. 11, pp. 1–28, figs. 1–8.

——. 1940. Notes from a herpetological diary, II. Copeia, no. 1, pp. 15–18.

Mosauer, Walter. 1935. The reptiles of a sand dune area and its surroundings in the Colorado desert, California: a study in habitat preference. Ecology, 16: 13–27, figs. 1–9.

Rodgers, Thomas H. 1944. A new skink from the Sierra Nevada of California. Copeia, no. 2, pp. 101–104, figs. 1–2, table.

Shreve, Benjamin. 1935. A California record for *Holbrookia*. Copeia, no. 4, p. 185.

Stebbins, Robert C. 1944. Field notes on a lizard, the mountain swift, with special reference to territorial behavior. Ecology, 25: 233–245, figs. 1–2.

Stejneger, Leonhard. 1893. Annotated list of the reptiles and batrachians collected by the Death Valley Expedition in 1891, with descriptions of new species. N. Amer. Fauna, no. 7, pp. 159–228, pls. 1–4.

Van Denburgh, John. 1905. The reptiles and amphibians of the islands of the Pacific coast of North America from the Farallons to Cape San Lucas and the Revilla Gigedos. Proc. Calif. Acad. Sci., 3d ser., 4: 1–40, pls. 1–8.

Von Bloeker, Jack C., Jr. 1942. Amphibians and reptiles of the dunes. Bull. Southern Calif. Acad. Sci., 41: 29–38.

Wood, Wallace F. 1935. Some observations on the intestinal protozoa of Californian lizards. Journ. Paras., 21: 165–174, figs. 1–18.

COLORADO: *Species Reported*

1. Cnemidophorus gularis octolineatus
2. Cnemidophorus sexlineatus
3. Cnemidophorus tesselatus tesselatus
4. Crotaphytus collaris baileyi
5. Crotaphytus collaris collaris
6. Eumeces multivirgatus
7. Eumeces obsoletus
8. Gambelia wislizenii wislizenii
9. Holbrookia maculata approximans
10. Holbrookia maculata maculata
11. Phrynosoma cornutum
12. Phrynosoma douglassii brevirostre
13. Phrynosoma douglassii ornatissimum
14. Phrynosoma modestum
15. Sceloporus graciosus graciosus
16. Sceloporus magister magister
17. Sceloporus undulatus elongatus
18. Sceloporus undulatus garmani
19. Sceloporus undulatus tristichus
20. Urosaurus ornatus wrighti
21. Uta stansburiana stansburiana

References:

Barry, Lewis T. 1932. An extension of the range of four reptiles to include Colorado. Copeia, no. 2, p. 103.
——. 1933. Notes on Colorado reptiles. Copeia, no. 2, pp. 99–100.
Burt, Charles E. 1933. (See *Arizona.*)
Cary, Merritt. 1911. A biological survey of Colorado. N. Amer. Fauna, no. 33, pp. 1–256, pls. 1–12, figs. 1–39.
Ellis, Max M., and Junius Henderson. 1913. The amphibia and reptilia of Colorado. Part I. Univ. Colo. Studies, 10: 39–129, pls. 1–8, tables 1–6.
——, and Junius Henderson. 1915. Amphibia and reptilia of Colorado. Part II. Univ. Colo. Studies, 11: 253–263, pls. 1–2.
Rodeck, Hugo G. 1936. Colorado records. Copeia, no. 1, p. 70.

CONNECTICUT: *Species Recorded*

1. Eumeces fasciatus

References:

Babbitt, Lewis H. 1939. The blue-tailed skink in Connecticut. New Engl. Nat., no. 4, pp. 14–16, ill.
Babcock, Harold L. 1930. New England lizard records. Bull. Boston Soc. Nat. Hist., 57: 9–12, ill.
Lamson, George Herbert. 1935. The reptiles of Connecticut. Conn. State Geol. Nat. Hist. Surv. Bull., no. 54, pp. 1–35, pls. 1–12.

DELAWARE: *Species Recorded*

1. Eumeces fasciatus
2. Sceloporus undulatus hyacinthinus

Reference:

Fowler, Henry E. 1925. Records of amphibians and reptiles for Delaware, Maryland and Virginia. Copeia, nos. 145, pp. 57–64; 146, pp. 65–67.

DISTRICT OF COLUMBIA: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Leiolopisma laterale
4. Sceloporus undulatus hyacinthinus

Reference:

Hay, W. P. 1902. A list of the batrachians and reptiles of the District of Columbia and vicinity. Proc. Biol. Soc. Wash., 15: 121–145, figs. 1–3.

FLORIDA: *Species Recorded*

1. Anolis carolinensis
2. Anolis stejnegeri
3. Cnemidophorus sexlineatus
4. Eumeces egregius
5. Eumeces inexpectatus
6. Eumeces laticeps
7. Eumeces onocrepis
*8. Gonatodes fuscus
*9. Hemidactylus turcicus turcicus
*10. Leiocephalus carinatus virescens
11. Leiolopisma laterale
12. Neoseps reynoldsi
13. Ophisaurus ventralis
14. Rhineura floridana
15. Sceloporus undulatus undulatus
16. Sceloporus woodi
*17. Sphaerodactylus cinereus
*18. Sphaerodactylus notatus

References:

Barbour, Thomas. 1921. *Sphaerodactylus*. Mem. Mus. Comp. Zool., 47: 215–278, pls. 1–26.
——. 1931. A new North American lizard. Copeia, no. 3, pp. 87–89.
——. 1936. Two introduced lizards in Miami, Florida. Copeia, no. 2, p. 113.
——, and Charles T. Ramsden. 1919. The herpetology of Cuba. Mem. Mus. Comp. Zool., 47: 69–213, pls. 1–15.
Burt, C. E. 1939. (See *Alabama*.)
Carr, A. F. 1940. A contribution to the herpetology of Florida. Univ. Fla. Publ., Biol. Ser., 3: i–iv, 1–118.
Goin, Coleman, J. 1940. Does *Eumeces fasciatus* (Linnaeus) occur in Florida? Copeia, no. 1, p. 52.
Grant, Chapman. 1940. The herpetology of Jamaica. II. The reptiles. Bull. Inst. Jamaica, Sci. Ser., no. 1, pp. 61–148, figs. 1–3.
Loveridge, Arthur. 1941. Certain Afro-American geckos of the genus *Hemidactylus*. Copeia, no. 4, pp. 245–248.
Stejneger, Leonhard. 1910. A new genus and species of lizard from Florida. Proc. U.S. Nat. Mus., 39: 33–35, figs. 1–6.
——. 1918. Description of a new snapping turtle and a new lizard from Florida. Proc. Biol. Soc. Wash., 31: 89–92.

GEORGIA: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus sexlineatus
3. Eumeces anthracinus
4. Eumeces egregius
5. Eumeces fasciatus
6. Eumeces inexpectatus

7. Eumeces laticeps
8. Leiolopisma laterale
9. Ophisaurus ventralis
10. Sceloporus undulatus hyacinthinus
11. Sceloporus undulatus undulatus

References:

Burt, C. E. 1939. (See *Alabama.*)
McCauley, Robert H. 1940. A record of *Eumeces anthracinus* for Georgia. Copeia, no. 1, p. 50.
Neill, Wilfred T., Jr. 1940. *Eumeces egregius* in Georgia. Copeia, no. 4, p. 266.
Wright, A. H., and W. D. Funkhouser. 1915. A biological reconnaissance in Georgia. The reptiles. I. Turtles, lizards and alligators. Proc. Acad. Nat. Sci. Phila., 1915, pp. 107–139, figs. 1–4, pls. 1, 2.

IDAHO: *Species Recorded*

1. Cnemidophorus tesselatus tesselatus
2. Crotaphytus collaris baileyi
3. Eumeces skiltonianus
4. Gambelia wislizenii wislizenii
5. Gerrhonotus coeruleus principis
6. Phrynosoma douglassii ornatissimum
7. Phrynosoma platyrhinos platyrhinos
8. Sceloporus graciosus graciosus
9. Sceloporus occidentalis biseriatus
10. Uta stansburiana stansburiana

References:

Cole, A. C. 1932. Analyses of the stomach contents of two species of Idaho lizards, with special references to the formicidae. Ann. Ent. Soc. Amer., 25: 638–640.[1]
Slater, James R. 1941. The distribution of amphibians and reptiles in Idaho. Occ. Pap. Dept. Biol. Coll. Puget Sound, no. 14, pp. 78–109.
Tanner, Wilmer W. 1941. The reptiles and amphibians of Idaho. No. 1. Great Basin Nat., 2: 87–97.

ILLINOIS: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces laticeps
4. Leiolopisma laterale
5. Ophisaurus ventralis
6. Sceloporus undulatus hyacinthinus

References:

Cagle, Fred R. 1941. Key to the reptiles and amphibians of Illinois. Contr. Mus. National and Social Sci. S. Ill. Norm. Univ., no. 5, pp. 1–32, pls. 1–3.
——. 1942. Herpetological fauna of Jackson and Union counties, Illinois. Amer. Midl. Nat., 28: 164–200, figs. 1–15.
Garman, H. 1892. A synopsis of the reptiles and amphibians of Illinois. Bull. Ill. State Lab. Nat. Hist., 3: 215–388, pls. 9–15.
Necker, Walter L. 1939. Records of amphibians and reptiles of the Chicago region, 1935–1938. Bull. Chi. Acad. Sci., 6: 1–10.

[1] *Uta levis* of that paper is *U. s. stansburiana.*

——. 1939. Revised check list of reptiles and amphibians of the Chicago region. Leaflet Chi. Acad. Sci., no. 11, pp. 1–4.

INDIANA: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces laticeps
4. Leiolopisma laterale
5. Ophisaurus ventralis
6. Sceloporus undulatus hyacinthinus

References:

Coe, John Edwin. 1944. The glass-snake. Chicago Nat., 7: 38–41, figs. 1–3.
Hay, O. P. 1892. The batrachians and reptiles of the state of Indiana. Ind. Dept. Geol. Nat. Res. Ann. Rept., no. 17, pp. 409–609, pls. 1–3.
Minton, Sherman. 1944. Introduction to the study of the reptiles of Indiana. Amer. Midl. Nat., 32: 438–477.
Myers, George S. 1926. A synopsis for the identification of the amphibians and reptiles of Indiana. Proc. Ind. Acad. Sci., 35: 277–294.
——. 1927. Notes on Indiana amphibians and reptiles. Proc. Ind. Acad. Sci., 36: 337–340.
Necker, Walter L. 1939. (See *Illinois*, both papers.)
Piatt, Jean. 1931. Herpetological report of Morgan County, Indiana. Proc. Ind. Acad. Sci., 40: 361–368.

IOWA: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces obsoletus
4. Eumeces septentrionalis septentrionalis
5. Ophisaurus ventralis
6. Sceloporus undulatus hyacinthinus

References:

Bailey, Reeve M. 1944. Four species new to the Iowa herpetofauna, with notes on their natural histories. Proc. Iowa Acad. Sci., 50: 347–352.
Osborn, Herbert. 1891. A partial catalogue of the animals of Iowa, represented in the collections of the department of zoology and entomology of the Iowa Agricultural College. Bull. Dept. Ent. Iowa Agri. Coll., no. 4, pp. 1–39.
Scott, Thomas G., and Reuben B. Shendahl. 1937. Black-banded skink in Iowa. Copeia, No. 3, p. 192.
Somes, M. P. 1911. Notes on some Iowa reptiles. Proc. Iowa Acad. Sci., 18: 149–154.

KANSAS: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Crotaphytus collaris collaris
3. Eumeces anthracinus
4. Eumeces fasciatus
5. Eumeces obsoletus
6. Eumeces septentrionalis septentrionalis
7. Holbrookia maculata maculata

8. Leiolopisma laterale
9. Ophisaurus ventralis
10. Phrynosoma cornutum
11. Phrynosoma douglassii brevirostre
12. Sceloporus undulatus hyacinthinus
13. Sceloporus undulatus garmani

References:

Brennan, L. A. 1938. A study of the habitat of reptiles and amphibians in Ellis County, Kansas. Trans. Kans. Acad. Sci., 40: 341–347.

Breukelman, John, and Allen Downs. 1936. A list of amphibia and reptiles of Chase and Lyon counties, Kansas. Trans. Kans. Acad. Sci., 39: 267–268.

Burt, Charles E. 1928. The lizards of Kansas. Trans. St. Louis Acad. Sci., 26: 1–81.

——. 1928. Insect food of Kansas lizards with notes on feeding habits. Journ. Kans. Ent. Soc., 1: 50–68.

——. 1933. Some distributional and ecological records of Kansas reptiles. Trans. Kans. Acad. Sci., 36: 186–208.

——. 1935. Further records of the ecology and distribution of amphibians and reptiles in the Middle West. Amer. Midl. Nat., 16: 311–366.

——, and Luther Hoyle. 1935. Additional records of the reptiles of the central prairie region of the United States. Trans. Kans. Acad. Sci., 37: 193–216.

Gloyd, Howard K. 1928. The amphibians and reptiles of Franklin County, Kansas. Trans. Kans. Acad. Sci., 31: 115–141.

——. 1932. The herpetological fauna of the Pigeon Lake region, Miami County, Kansas. Pap. Mich. Acad. Sci., Arts Lett., 15: 389–409, pls. 30–32.

Hartman, F. A. 1906. Food habits of Kansas lizards and batrachians. Trans. Kans. Acad. Sci., 20: 225–229.

Marr, John C. 1944. (See *Texas.*)

Taylor, E. H. 1929. List of reptiles and batrachians of Morton County, Kansas, reporting species new to the state fauna. Univ. Kans. Sci. Bull., 19: 163–165.

Tihen, Joe O. 1938. Additional distributional records of amphibians and reptiles in Kansas counties. Trans. Kans. Acad. Sci., 40: 401–409.

——, and James M. Sprague. 1939. Amphibians, reptiles and mammals of the Meade county state park. Trans. Kans. Acad. Sci., 42: 499–512, pls. 1–3.

KENTUCKY: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces anthracinus
3. Eumeces fasciatus
4. Eumeces laticeps
5. Leiolopisma laterale
6. Ophisaurus ventralis
7. Sceloporus undulatus hyacinthinus

References:

Bishop, S. C. 1926. Records of some amphibians and reptiles from Kentucky. Copeia, no. 152, pp. 118–120.

Burt, C. E. 1933. A contribution to the herpetology of Kentucky. Amer. Midl. Nat., 14: 669–679.

Dury, Ralph, and Raymond S. Williams. 1933. Notes on some Kentucky amphibians and reptiles. Bull. Baker-Hunt Foundation Mus., no. 1, pp. 1–22.

Hibbard, C. W. 1937. The amphibians and reptiles of Mammoth Cave National Park proposed. Trans. Kans. Acad. Sci., 39: 277–281.
Welter, Wilfred A., and Katherine Carr. 1939. Amphibians and reptiles of northeastern Kentucky. Copeia, no. 3, pp. 128–130.

LOUISIANA: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus sexlineatus
*3. Crotaphytus collaris collaris
4. Eumeces anthracinus
5. Eumeces fasciatus
6. Eumeces inexpectatus
7. Eumeces laticeps
8. Leiolopisma laterale
9. Ophisaurus ventralis
*10. Phrynosoma cornutum
11. Sceloporus undulatus hyacinthinus
12. Sceloporus undulatus undulatus

References:

Frierson, L. S., Jr. 1927. *Crotaphytus collaris collaris* at Taylor Town, Louisiana. Copeia, no. 165, pp. 113–114.
——. 1927. *Phrynosoma cornutum* (Harlan) in Louisiana. Copeia, no. 165, p. 114.
McIlhenny, E. A. 1937. Notes on the five-lined skink, Copeia, no. 4, pp. 232–233.
Strecker, John K., and L. S. Frierson, Jr. 1926. The herpetology of Caddo and De Soto parishes, Louisiana. Contr. Baylor Univ. Mus., no. 5, pp. 1–10.
Viosca, Percy. 1931. Amphibians and reptiles of Louisiana. Southern Biol. Supply Co., Price list no. 20, pp. 1–12.

MAINE

No lizards are known and none appear as likely inhabitants.

MARYLAND: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces anthracinus
3. Eumeces fasciatus
4. Eumeces laticeps
5. Leiolopisma laterale
6. Sceloporus undulatus hyacinthinus

References:

Burt, C. E. 1931. (See *General Literature.*)
Fowler, Henry E. 1925. (See *Delaware.*)
McCauley, Robert Henry, Jr. 1939. Notes on the food habits of certain Maryland lizards. Amer. Midl. Nat., 22: 150–153.
——. 1940. A distributional study of the reptiles of Maryland and the District of Columbia. Cornell Univ. Abstracts of Theses, 1940, pp. 267–269.
McClellan, William H., Romeo Mansueti and Francis Groves. 1943. The lizards of central and southern Maryland. Proc. Nat. Hist. Soc. Maryland, no. 8, pp. 1–42.
Taylor, E. H. 1936. (See *General Literature.*)

MASSACHUSETTS: *Species Recorded*

1. Eumeces fasciatus

Reference:

Babcock, Harold L. 1930. (See *Connecticut.*)

MICHIGAN: *Species Recorded*

1. Eumeces fasciatus

Reference:

Ruthven, Alexander G., Crystal Thompson, and Helen T. Gaige. 1928. The herpetology of Michigan. Mich. Handbook Ser., no. 3, pp. i–x, 1–230, frontis., pls. 1–19, figs. 1–52.

MINNESOTA: *Species Recorded*

1. Eumeces fasciatus
2. Eumeces septentrionalis septentrionalis

References:

Breckenridge, W. J. 1943. The life history of the black-banded skink *Eumeces septentrionalis septentrionalis* (Baird). Amer. Midl. Nat., 29: 591-606, figs. 1–7.
Taylor, E. H. 1936. (See *General Literature.*)

MISSISSIPPI: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus sexlineatus
3. Eumeces anthracinus
4. Eumeces fasciatus
5. Eumeces inexpectatus
6. Eumeces laticeps
7. Leiolopisma laterale
8. Ophisaurus ventralis
9. Sceloporus undulatus hyacinthinus
10. Sceloporus undulatus undulatus

References:

Allen, Morrow J. 1932. A survey of the amphibians and reptiles of Harrison County, Mississippi. Amer. Mus. Nov., no. 542, pp. 1–20.
Burt, C. E. 1931. (See *General Literature.*)
——. 1939. (See *Alabama.*)
Cook, Fannye A. 1942. Alligator and lizards of Mississippi. Bull. Miss. State Game and Fish Comm., pp. i–v, 1–20.
Corrington, Julian D. 1927. Field notes on some amphibians and reptiles at Biloxi, Mississippi. Copeia, no. 165, pp. 98–102.

MISSOURI: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Crotaphytus collaris collaris
3. Eumeces anthracinus
4. Eumeces fasciatus
5. Eumeces laticeps
6. Eumeces obsoletus
7. Leiolopisma laterale
8. Ophisaurus ventralis
9. Phrynosoma cornutum
10. Sceloporus undulatus hyacinthinus

References:

Anderson, Paul. 1942. Amphibians and reptiles of Jackson County, Missouri. Bull. Chicago Acad. Sci., 6: 203–220.

Boyer, Dorothy A., and Albert O. Heinze. 1934. An annotated list of the amphibians and reptiles of Jefferson County, Mo. Trans. St. Louis Acad. Sci., 28: 183–200, figs. 1–2.

Hurter, Julius. 1911. Herpetology of Missouri. Trans. St. Louis Acad. Sci., 20: 59–274, pls. 18–24.

MONTANA: *Species Recorded*

1. Eumeces skiltonianus
2. Gerrhonotus coeruleus principis
3. Phrynosoma douglassii brevirostre
4. Sceloporus graciosus graciosus

References:

Cooper, J. G. 1869. Notes on the fauna of the upper Missouri. Amer. Nat., 3: 294–299.

Coues, Elliott, and H. C. Yarrow. 1878. Notes on the herpetology of Dakota and Montana. Bull. U.S. Geol. Surv., 4: 259–291.

Rodgers, Thomas, and William L. Jellison. 1942. A collection of amphibians and reptiles from western Montana. Copeia, no. 1, pp. 10–13.

Stone, Witmer. 1911. (See *Colorado.*)

NEBRASKA: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces multivirgatus
4. Eumeces obsoletus
5. Eumeces septentrionalis septentrionalis
6. Holbrookia maculata maculata
7. Ophisaurus ventralis
8. Phrynosoma douglassii brevirostre
9. Sceloporus undulatus garmani

References:

Hudson, George E. 1942. The amphibians and reptiles of Nebraska. Nebr. Cons. Bull., no. 24, pp. i–iv, 1–146, pls. 1–20, maps 1–32.

Marr, John C. 1944. (See *Texas.*)

NEVADA: *Species Reported*

1. Callisaurus draconoides gabbii
2. Callisaurus draconoides myurus
3. Cnemidophorus tesselatus tesselatus
4. Coleonyx variegatus
5. Crotaphytus collaris baileyi
6. Dipsosaurus dorsalis dorsalis
7. Eumeces skiltonianus
8. Gambelia wislizenii wislizenii
9. Heloderma suspectum
10. Phrynosoma douglassii ornatissimum
11. Phrynosoma platyrhinos platyrhinos
12. Sauromalus obesus

13. Sceloporus graciosus graciosus
14. Sceloporus magister magister
15. Sceloporus occidentalis biseriatus
16. Urosaurus graciosus
17. Urosaurus ornatus symmetricus
18. Uta stansburiana stansburiana
19. Uta stansburiana stejnegeri
20. Xantusia vigilis

References:

Linsdale, Jean M. 1938. Environmental responses of vertebrates in the Great Basin. Amer. Midl. Nat., 19: 1–206, figs. 1–12.

——. 1940. Amphibians and reptiles in Nevada. Proc. Amer. Acad. Arts Sci., 73: 195–257, maps 1–29.

Richardson, C. H. 1915. Reptiles of northwestern Nevada and adjacent territory. Proc. U.S. Nat. Mus., 48: 403–435.

Ruthven, Alexander G. 1915. Description of a new *Uta* from Nevada. Proc. Biol. Soc. Wash., 26: 27–29, fig. 1.

——, and Helen Thompson Gaige. 1915. The reptiles and amphibians collected in northeastern Nevada by the Walker-Newcomb expedition of the University of Michigan. Occ. Pap. Mus. Zool. Univ. Mich., no. 8, pp. 1–33, pls. 1–5.

Taylor, Walter P. 1912. Field notes on amphibians, reptiles and birds of northern Humboldt County, Nevada, with a discussion of some of the faunal features of the region. Univ. Calif. Publ. Zool., 7: 319–436, pls. 7–12.

NEW HAMPSHIRE

No lizards are known and none appear as likely inhabitants.

NEW JERSEY: *Species Recorded*

1. Eumeces fasciatus
2. Leiolopisma laterale
3. Sceloporus undulatus hyacinthinus

References:

Conant, Roger, and Reeve M. Bailey. 1936. Some herpetological records from Monmouth and Ocean counties, New Jersey. Occ. Pap. Mus. Zool. Univ. Mich. no. 328, pp. 1–10.

Fowler, Henry W. 1907. The amphibians and reptiles of New Jersey. Ann. Rept. N.J. State Mus., 1906, pp. 23–250, pls. 1–69, figs.

Klots, Alexander Barrett. 1930. Notes on amphibia and lacertilia collected at Weymouth, N.J. Copeia, no. 173, pp. 107–109.

Streets, J. F. 1914. Amphibians and reptiles observed at Beverly, N.J. Copeia, no. 4, p. 2.

NEW MEXICO: *Species Recorded*

1. Cnemidophorus grahamii
2. Cnemidophorus gularis gularis
3. Cnemidophorus gularis octolineatus
4. Cnemidophorus perplexus
5. Cnemidophorus tesselatus aethiops
6. Cnemidophorus tesselatus tesselatus

7. Coleonyx brevis
8. Crotaphytus collaris baileyi
9. Crotaphytus collaris collaris
10. Eumeces gaigei
11. Eumeces multivirgatus
12. Eumeces obsoletus
13. Eumeces taylori
14. Gambelia wislizenii wislizenii
15. Gerrhonotus kingii
16. Holbrookia maculata approximans
17. Holbrookia maculata maculata
18. Holbrookia maculata ruthveni
19. Holbrookia texana
20. Phrynosoma cornutum
21. Phrynosoma douglassii hernandesi
22. Phrynosoma douglassii ornatissimum
23. Phrynosoma modestum
24. Sceloporus clarkii clarkii
25. Sceloporus graciosus graciosus
26. Sceloporus jarrovii jarrovii
27. Sceloporus magister magister
28. Sceloporus olivaceus
29. Sceloporus poinsettii
30. Sceloporus undulatus consobrinus
31. Sceloporus undulatus elongatus
32. Sceloporus undulatus tristichus
33. Urosaurus ornatus linearis
34. Urosaurus ornatus levis
35. Urosaurus ornatus schmidti
36. Urosaurus ornatus wrighti
37. Uta stansburiana stansburiana
38. Uta stansburiana stejnegeri

References:

Bailey, Joseph R. 1937. Three additional specimens of *Eumeces gaigei*. Herpetologica, 1: 96.

Bailey, Vernon. 1913. Life zones and crop zones of New Mexico. N. Amer. Fauna, 35: 1–100, pls. 1–16, figs. 1–6, map.

Bugbee, Robert E. 1942. Notes on animal occurrence and activity in the White Sands National Monument, New Mexico. Trans. Kans. Acad. Sci., 45: 315–321, map 1, fig. 1.

Burt, Charles E. 1933. (See *Arizona.*)

——. 1935. (See *Kansas.*)

——, and M. D. Burt. 1929. (See *Arizona.*)

Little, Elbert L., and J. G. Keller. 1937. Amphibians and reptiles of the Jornada Experimental Range, New Mexico. Copeia, no. 4, pp. 216–222.

Mosauer, Walter. 1932. The amphibians and reptiles of the Guadalupe Mountains of New Mexico and Texas. Occ. Pap. Mus. Zool. Univ. Mich., no. 246, pp. 1–18, pl. 1.

Ruthven, A. G. 1907. (See *Arizona.*)

Smith, Hobart M. 1943. The White Sands Earless Lizard. Zool. Ser. Field Mus Nat. Hist., 24: 339–344.

Van Denburgh, John 1924. Notes on the herpetology of New Mexico with a list of species known from that state. Proc. Calif. Acad. Sci., 4th ser., 13: 189–230.

NEW YORK: *Species Recorded*

1. Eumeces anthracinus
2. Eumeces fasciatus
3. Sceloporus undulatus hyacinthinus

References:

Bishop, Sherman C. 1918. Note on lizards of New York. Copeia, no. 54, pp. 35–36.
Clausen, Robert T. 1938. Notes on *Eumeces anthracinus* in central New York. Copeia, no. 1, pp. 3–7, figs. 1–2.
Hassler, William G. 1927. The fence lizard in the Hudson River Valley. Copeia, no. 163, pp. 48–50.
Taylor, 1939. (See *General Literature.*)

NORTH CAROLINA: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus sexlineatus
3. Eumeces anthracinus
4. Eumeces fasciatus
5. Eumeces inexpectatus
6. Eumeces laticeps
7. Leiolopisma laterale
8. Ophisaurus ventralis
9. Sceloporus undulatus hyacinthinus

References:

Brimley, C. S. 1941. The amphibians and reptiles of North Carolina. Carolina Tips, 4: 6–7, 10–11, 14–15 (lizards only).
Burt, C. E. 1939. (See *Alabama.*)
King, Willis. 1939. A survey of the herpetology of Great Smoky Mountains National Park. Amer. Midl. Nat., 21: 531–582, figs. 1–8.

NORTH DAKOTA: *Species Recorded*

1. Eumeces septentrionalis septentrionalis

Reference:

Taylor, E. H. 1936. (See *General Literature.*)

OHIO: *Species Recorded*

1. Eumeces fasciatus
2. Eumeces laticeps
3. Leiolopisma laterale
4. Sceloporus undulatus hyacinthinus

Reference:

Conant, Roger. 1938. The reptiles of Ohio. Amer. Midl. Nat., 20: 1–200, pls. 1–26, maps 1–38.

OKLAHOMA: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus gularis gularis
3. Cnemidophorus sexlineatus
4. Crotaphytus collaris collaris
5. Eumeces anthracinus
6. Eumeces fasciatus
7. Eumeces laticeps
8. Eumeces obsoletus
9. Eumeces septentrionalis obtusirostris
10. Eumeces septentrionalis septentrionalis
11. Holbrookia maculata lacerata

12. Holbrookia maculata maculata
13. Leiolopisma laterale
14. Ophisaurus ventralis
15. Phrynosoma cornutum
16. Sceloporus olivaceus
17. Sceloporus undulatus elongatus
18. Sceloporus undulatus garmani
19. Sceloporus undulatus hyacinthinus

References:

Burt, C. E. 1935. (See *Kansas.*)

Force, Edith R. 1930. The amphibians and reptiles of Tulsa County, Oklahoma, and vicinity. Copeia, no. 1, pp. 25–39.

Marr, John C. 1944. (See *Texas.*)

Ortenburger, A. I. 1926. A report on the amphibians and reptiles of Oklahoma. Proc. Okla. Acad. Sci., 6: 89–100.

——. 1930. A key to the lizards and snakes of Oklahoma. Publ. Univ. Okla. Biol. Surv., 2: 209–239, figs. 1–44.

——, and Beryl Freeman. 1930. Notes on some reptiles and amphibians from western Oklahoma. Publ. Univ. Okla. Biol. Surv. 2: 175–188.

Smith, H. M., and A. B. Leonard. 1934. Distributional records of reptiles and amphibians in Oklahoma. Amer. Midl. Nat., 15: 190–196.

Trowbridge, Albert H. 1937. Ecological observations on amphibians and reptiles collected in southeastern Oklahoma during the summer of 1934. Amer. Midl. Nat., 18: 285–303.

OREGON: *Species Reported*

1. Cnemidophorus tesselatus tesselatus
2. Crotaphytus collaris baileyi
3. Eumeces skiltonianus
4. Gambelia wislizenii wislizenii
5. Gerrhonotus coeruleus principis
6. Gerrhonotus coeruleus shastensis
7. Gerrhonotus multicarinatus scincicauda
8. Phrynosoma douglassii douglassii
9. Phrynosoma platyrhinos platyrhinos
10. Sceloporus graciosus gracilis
11. Sceloporus graciosus graciosus
12. Sceloporus occidentalis biseriatus
13. Sceloporus occidentalis occidentalis
14. Uta stansburiana stansburiana

References:

Anderson, Oscar I., and James R. Slater. 1941. Life zone distribution of the Oregon reptiles. Occ. Pap. Dept. Biol. Coll. Puget Sound, no. 15, pp. 109–119.

Brooking, Walter J. 1934. Some reptiles and amphibians from Malheur County, in eastern Oregon, Copeia, no. 1, pp. 93–95.

Fitch, Henry S. 1936. Amphibians and reptiles of the Rogue River Basin, Oregon. Amer. Midl. Nat., 17: 634–652.

Gordon, Kenneth. 1939. The amphibia and reptilia of Oregon. Oregon State Mono., Std. Zool., no. 1, pp. 1–82, figs. 1–54.

PENNSYLVANIA: *Species Recorded*

1. Eumeces anthracinus
2. Eumeces fasciatus
3. Eumeces laticeps
4. Sceloporus undulatus hyacinthinus

References:

Netting, M. Graham. 1930. The occurrence of lizards in Pennsylvania. Ann. Carn. Mus., 19: 169–174.
——. 1939. The reptiles of Pennsylvania. Bien. Rept. Pa. Fish Comm., 1936–1938, pp. 122–132.
Surface, H. A. 1908. The lizards of Pennsylvania. Zool. Bull. Div. Zool. Pa. Dept. Agri., 5: 233–264, pls. 30–33, figs. 26–28.

RHODE ISLAND

No lizards are known, although *Eumeces fasciatus* may possibly occur.

SOUTH CAROLINA: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus sexlineatus
3. Eumeces fasciatus
4. Eumeces inexpectatus
5. Eumeces laticeps
6. Leiolopisma laterale
7. Ophisaurus ventralis
8. Sceloporus undulatus hyacinthinus
9. Sceloporus undulatus undulatus

References:

Burt, C. E. 1939. (See *Alabama.*)
Corrington, Julian D. 1929. Herpetology of the Columbia, South Carolina, region. Copeia, no. 172, pp. 58–83.
Jopson, Harry G. M. 1940. Reptiles and amphibians from Georgetown County, South Carolina. Herpetologica, 2: 39–43.
Smith, H. M. 1938. (See *Alabama.*)
Taylor, E. H. 1936. (See *General Literature.*)

SOUTH DAKOTA: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces multivirgatus
4. Eumeces septentrionalis septentrionalis
5. Holbrookia maculata maculata
6. Phrynosoma douglassii brevirostre
7. Sceloporus undulatus garmani

References:

Boulenger, G. A. 1882. Description of an apparently new species of lizard of the genus *Sceloporus*. Proc. Zool. Soc. Lond., 1882, pp. 761–762, pl. 56, colored.
Over, William H. 1923. Amphibians and reptiles of South Dakota. Bull. Univ. South Dakota, 23d. ser., no. 10, pp. 1–34, pls. 1–18.
——. 1943. Amphibians and reptiles of South Dakota. 2d ed., rev. Univ. S. Dak. Nat. Hist. Studies, no. 6, pp. 1–31, figs. 1–20.
Taylor, E. H. 1936. (See *General Literature.*)

TENNESSEE: *Species Recorded*

1. Anolis carolinensis
2. Eumeces fasciatus
3. Eumeces inexpectatus
4. Eumeces laticeps
5. Leiolopisma laterale
6. Ophisaurus ventralis
7. Sceloporus undulatus hyacinthinus

References:

Blanchard, F. N. 1922. The amphibians and reptiles of western Tennessee. Occ. Pap. Mus. Zool. Univ. Mich., no. 117, pp. 1–18.

Burt, C. E. 1939. (See *Alabama*.)

Cahn, Alvin R. 1939. *Anolis carolinensis* in Tennessee. Copeia, no. 3, p. 169.

Jones, J. Paul, and B. C. V. Ressler. 1927. The occurrence of *Anolis carolinensis* Voight in eastern Tennessee. Copeia, no. 164, pp. 87–88.

King, Willis. 1939. (See *North Carolina*.)

Parker, Malcolm V. 1939. The amphibians and reptiles of Reelfoot Lake and vicinity, with a key for the separation of species and subspecies. Journ. Tenn. Acad. Sci., 14: 72–101, figs. 1–14.

TEXAS: *Species Recorded*

1. Anolis carolinensis
2. Cnemidophorus grahamii
3. Cnemidophorus gularis gularis
4. Cnemidophorus gularis octolineatus
5. Cnemidophorus perplexus
6. Cnemidophorus sexlineatus
7. Cnemidophorus tesselatus tesselatus
8. Coleonyx brevis
9. Crotaphytus collaris baileyi
10. Crotaphytus collaris collaris
11. Crotaphytus reticulatus
12. Eumeces anthracinus
13. Eumeces brevilineatus
14. Eumeces fasciatus
15. Eumeces gaigei
16. Eumeces laticeps
17. Eumeces multivirgatus
18. Eumeces obsoletus
19. Eumeces septentrionalis obtusirostris
20. Eumeces taylori
21. Eumeces tetragrammus
22. Gambelia wislizenii wislizenii
23. Gerrhonotus liocephalus infernalis
24. •Hemidactylus turcicus turcicus [2]
25. Holbrookia maculata approximans
26. Holbrookia maculata lacerata
27. Holbrookia propinqua
28. Holbrookia texana
29. Leiolopisma laterale
30. Ophisaurus ventralis
31. Phrynosoma cornutum
32. Phrynosoma douglassii hernandesi
33. Phrynosoma modestum
34. Sceloporus cyanogenys
35. Sceloporus grammicus disparilis
36. Sceloporus magister magister
37. Sceloporus merriami annulatus

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[2] This is reported from Texas by S. S. Flower, Notes on the recent reptiles and amphibians of Egypt, with a list of the species recorded from that kingdom, *Proc. Zool. Soc. Lond.*, 1933, pp. 735–851, 1 text fig., map.

38. Sceloporus merriami merriami
39. Sceloporus olivaceus
40. Sceloporus poinsettii
41. Sceloporus undulatus consobrinus
42. Sceloporus undulatus hyacinthinus
43. Sceloporus variabilis marmoratus
44. Urosaurus ornatus ornatus
45. Urosaurus ornatus schmidti
46. Uta stansburiana stejnegeri

References:

Brown, Bryce C. 1942. Notes on *Crotaphytus reticulatus*. Copeia, no. 3, p. 176.

Harper, Francis. 1932. A new Texas subspecies of the lizard genus *Holbrookia*. Proc. Biol. Soc. Wash., 45: 15–18.

Marr, John C. 1944. Notes on amphibians and reptiles from the central United States. Amer. Midl. Nat., 32: 478–490.

Mosauer, Walter. 1932. (See *New Mexico*.)

Mulaik, Stanley. 1936. An ovoviviparous *Sceloporus* from Texas. Copeia, no. 1, p. 72.

Murray, Leo T. 1939. Annotated list of amphibians and reptiles from the Chisos Mountains. Contr. Baylor Univ. Mus., no. 24, pp. 4–16.

Schmidt, Karl P., and Tarleton F. Smith. 1944. Amphibians and reptiles of the Big Bend region of Texas. Zool. Ser. Field Mus. Nat. Hist., 29: 75–96.

Smith, H. M. 1935. Descriptions of new lizards of the genus *Sceloporus* from Mexico and southern United States. Trans. Kans. Acad. Sci., 37: 263–285, pls. 8–10.

——. 1937. A new subspecies of the lizard genus *Sceloporus* from Texas. Proc. Biol. Soc. Wash., 50: 83–86.

——. 1938. Additions to the herpetofauna of Mexico. Copeia, no. 3, pp. 149–150.

Strecker, John K. 1910. Notes on the fauna of northwestern Texas. Baylor Univ. Bull., 13: 1–31, pl., figs. 1–2.

——. 1915. Reptiles and amphibians of Texas. Baylor Univ. Bull., no. 18, pp. 1–82.

——. 1930. A catalogue of the amphibians and reptiles of Travis County, Texas. Contr. Baylor Univ. Mus., no. 23, pp. 1–16.

——, and Walter J. Williams. 1935. Notes on the zoology of Texas. Baylor Univ. Bull., 38 (3): i–vi, 1–69.

Taylor, Edward H. 1931. The discovery of a lizard *Sceloporus torquatus cyanogenys* Cope in Texas, new to the fauna of the United States. Proc. Biol. Soc. Wash., 44: 129–132.

Wright, A. H., and A. A. Wright. 1927. Notes on *Sceloporus merriami* Stejneger. Proc. Biol. Soc. Wash., 40: 57–64, pls. 1–3.

UTAH: *Species Reported*

1. Callisaurus draconoides gabbii
2. Coleonyx variegatus
3. Crotaphytus collaris baileyi
4. Cnemidophorus gularis octolineatus
5. Cnemidophorus tesselatus tesselatus
6. Dipsosaurus dorsalis dorsalis
7. Eumeces skiltonianus
8. Gambelia wislizenii wislizenii
9. Heloderma suspectum
10. Holbrookia maculata approximans
11. Phrynosoma douglassii ornatissimum
12. Phrynosoma douglassii ornatum
13. Phrynosoma platyrhinos platyrhinos
14. Sauromalus obesus
15. Sceloporus graciosus graciosus

16. Sceloporus magister magister
17. Sceloporus occidentalis biseriatus
18. Sceloporus undulatus elongatus
19. Sceloporus undulatus tristichus
20. Urosaurus ornatus wrighti
21. Uta stansburiana stansburiana
22. Uta stansburiana stejnegeri
23. Xantusia vigilis

References:

Hardy, Ross. 1944. Some habits of the banded gecko in Southwestern Utah. Proc. Utah Acad. Sci. Arts Letters, 21: 71–73.

Knowlton, George F.[3] 1938. Lizards in insect control. Ohio Journ. Sci., 38: 235–238.

Ruthven, Alexander G. 1926. Notes on Utah reptiles. Occ. Pap. Mus. Zool. Univ. Mich., no. 179, pp. 1–4.

——. 1932. Notes on the amphibians and reptiles of Utah. Occ. Pap. Mus. Zool. Univ. Mich., no. 243, pp. 1–4.

Stejneger, Leonhard. 1919. The name of the horned-toad from the Salt Lake Basin. Copeia, no. 65, pp. 3–4.

Storey, Margaret, 1940. *Xantusia vigilis* in Utah and Nevada. Copeia, no. 2, p. 135.

Stuart, L. C. 1932. The lizards of the middle Pahvant Valley, Utah; materials for a study in saurian distribution. Occ. Pap. Mus. Zool. Univ. Mich., no. 244, pp. 1–33, pls. 1–4.

Tanner, Vasco M. 1928. Distributional list of the amphibians and reptiles of Utah. Copeia, no. 166, pp. 23–28.

Tanner, Wilmer W. 1944. Notes on the life history of *Eumeces skiltonianus skiltonianus*. Great Basin Nat., 4: 81–88.

Woodbury, Angus M. 1931. A descriptive catalog of the reptiles of Utah. Bull. Univ. Utah, 21: i–xii, 1–129, figs. 1–58.

——. 1928. The reptiles of Zion National Park. Copeia, no. 166, pp. 14–21.

Woodbury, Lowell A. 1932. Notes on food habits of three species of lizards from Utah. Copeia, no. 1, pp. 13–16.

VERMONT

No lizards are known and none appear as likely inhabitants.

VIRGINIA: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces anthracinus
4. Eumeces inexpectatus
5. Eumeces laticeps
6. Leiolopisma laterale
7. Ophisaurus ventralis
8. Sceloporus undulatus hyacinthinus

References:

Burt, C. E. 1931. (See *General Literature*.)

Dunn, E. R. 1918. A preliminary list of the reptiles and amphibians of Virginia. Copeia, no. 53, pp. 16–27.

[3] The many papers by Knowlton, Pack, *et al*. on the food habits of Utah lizards are too numerous to be listed completely. Some are listed in "Literature Cited." Without question more is known about the food habits of Utah lizards than of those in any other state.

Hoffman, Richard L. 1944. *Eumeces anthracinus* (Baird) in Virginia. Proc. Biol. Soc. Washington, 57: 123–124.

——. 1944. Notes on *Cnemidophorus sexlineatus* in Virgina. Proc. Biol. Soc. Washington, 57: 124–125.

Richmond, Neil D., and Coleman J. Goin. 1938. Notes on a collection of amphibians and reptiles from New Kent County, Virginia. Ann. Carn. Mus., 27: 301–310.

Taylor, E. H. 1936. (See *General Literature.*)

WASHINGTON: *Species Recorded*

1. Eumeces skiltonianus
2. Gerrhonotus coeruleus principis
3. Gerrhonotus multicarinatus scincicauda
4. Phrynosoma douglassii douglassii
5. Phrynosoma platyrhinos platyrhinos
6. Sceloporus graciosus gracilis
7. Sceloporus occidentalis biseriatus
8. Sceloporus occidentalis occidentalis
9. Uta stansburiana stansburiana

References:

Cooper, J. G. 1860. Report upon the reptiles collected on the survey. Expl. Surv. R. R. Route W. Miss. River, 47th and 49th Par., Zool. Rept., pp. 292–306, pls. 12–17, 19–22, 29, 31.

Johnson, Murray L. 1942. A distributional check-list of the reptiles of Washington. Copeia, no. 1, pp. 15–18.

Owen, Robert P. 1940. A list of the reptiles of Washington. Copeia, no. 3, pp. 169–172.

Slater, James R., and Walter C. Brown. 1941. Island records of amphibians and reptiles for Washington. Occ. Pap. Dept. Biol. Coll. Puget Sound, no. 13, pp. 74–77.

Svihla, Arthur, and Ruth Dowell Svihla. 1933. Amphibians and reptiles of Whitman county, Washington. Copeia, no. 3, pp. 125–128.

WEST VIRGINIA: *Species Recorded*

1. Eumeces fasciatus
2. Eumeces laticeps
3. Leiolopisma laterale
4. Sceloporus undulatus hyacinthinus

References:

Green, N. Bayard. 1941. Amphibians and reptiles of the Huntington region. Marshall Review, 4: pp. 33–40.

Netting, M. Graham. 1934. A preliminary list of the amphibians and reptiles of West Virginia. Mimeographed MS., pp. 1–2.

Wilson, L. Wayne. 1941. An addition to the herpetofauna of West Virginia. Copeia, no. 4, p. 268.

WISCONSIN: *Species Recorded*

1. Cnemidophorus sexlineatus
2. Eumeces fasciatus
3. Eumeces septentrionalis septentrionalis
4. Ophisaurus ventralis

References:

Graenicher, S. 1911. Some records of Wisconsin lizards. Bull. Wisc. Nat. Hist. Soc., 9: 78–81.

Pope, T. E. B., and W. E. Dickinson. 1928. The amphibians and reptiles of Wisconsin. Bull. Public Mus. Milwaukee, 8: 78–81.

WYOMING: *Species Reported*

1. Cnemidophorus sexlineatus
2. Eumeces multivirgatus
3. Holbrookia maculata maculata
4. Phrynosoma douglassii brevirostre
5. Phrynosoma douglassii ornatissimum
6. Sceloporus graciosus graciosus
7. Sceloporus undulatus elongatus
8. Sceloporus undulatus garmani
9. Uta stansburiana stansburiana [4]

References:

Burt, C. E., and Luther Hoyle. 1935. (See *Kansas.*)

Cary, Merritt. 1917. Life zone investigations in Wyoming. N. Amer. Fauna, no. 42, pp. 1–95, pls. 1–15, figs. 1–17, map.

Stone, Witmer. 1911. (See *Colorado.*)

CANADA: *Species Recorded*

1. Eumeces fasciatus (Ont.)
2. Eumeces septentrionalis septentrionalis (Manitoba)
3. Eumeces skiltonianus (B.C.)
4. Gerrhonotus coeruleus principis (B.C.)
5. Phrynosoma douglassii douglassii (B.C.)
6. Sceloporus occidentalis biseriatus (B.C.) [5]

References:

Carl, G. Clifford. 1944. The reptiles of British Columbia. Brit. Col. Prov. Mus., Handbook, no. 3, pp. 1–60, ill.

Cowan, Ian McTaggart. 1936. A review of the reptiles and amphibians of British Columbia. Dept. Brit. Col. Mus., 1936, pp. K16–K25.

Logier, E. B. S. 1939. The reptiles of Ontario. Royal Ontario Mus. Zool. Handbook, no. 4, pp. 1–63, i–ii, pls. 1–7.

——, and G. C. Toner. 1942. Amphibians and reptiles of Canada. Canadian Field-Nat., 56: 15–16.

Patch, Clyde L. 1934. *Eumeces* in Canada. Copeia, no. 1, pp. 50–51.

[4] Listed by Cary, but not elsewhere recorded; very dubious (see map, p. 496).

[5] Apparently very dubious.

LITERATURE CITED

Atsatt, Sarah Rogers. 1939. Color changes as controlled by temperature and light in the lizards of the desert regions of southern California. Los Angeles Publ. Biol. Sci., 1: 237–276, pls. 8–12, figs. 1–9.

Babcock, H. L. 1934. The capture of the Bermudian lizard, *Eumeces longirostris* Cope. Copeia, no. 4, p. 182.

Bailey, J. W. 1928. A revision of the lizards of the genus *Ctenosaura*. Proc. U.S. Nat. Mus., 73: 1–55, pls. 1–30.

Baird, S. F. 1859. Reptiles of the boundary. U.S.–Mex. Bound. Surv., pp. 1–35, pls. 1–41.

Boulenger, G. A. 1888. On the scaling of the reproduced tail in lizards. Proc. Zool. Soc. London, 1888, pp. 351–353.

Bragg, Arthur N. 1943. Common names for frogs and toads in Oklahoma. Proc. Okla. Acad. Sci., 23: 39–40.

Breder, Ruth Bernice. 1922. The egg-laying of an anolis in captivity. Copeia, no. 107, pp. 45–46.

Brimley, C. S. 1903. Notes on the reproduction of certain reptiles. Amer. Nat., 37: 261–266.

Bruner, Henry L. 1907. On the cephalic veins and sinuses of reptiles, with description of a mechanism for raising the venous blood-pressure in the head. Amer. Journ. Anat., 7: 1–117, pls. 1–3, figs. 1–17.

Burleson, Gretchen Lyon. 1942. The source of blood ejected from the eye by horned toads. Copeia, no. 4, pp. 246–248, figs. 1, 2.

Burt, Charles E. 1927. On the type locality of the horned lizard (*Phrynosoma brevirostre* Girard). Copeia, no. 163, pp. 53–54.

——. 1931. An interpretation of certain experimental and observational data on the limbless lizard, *Anniella pulchra* Gray. Copeia, no. 3, pp. 105–106.

Cagle, Fred R. 1940. Eggs and natural nests of *Eumeces fasciatus*. Amer. Midl. Nat., 23: 227–233, figs. 1–12.

Cope, E. D. 1883. Notes on the geographical distribution of batrachia and reptilia in western North America. Proc. Acad. Nat. Sci. Phila., 35: 10–35.

Cowles, Raymond B. 1940. Additional implications of reptilian sensitivity to high temperatures. Amer. Nat., 74: 542–561.

——. 1941. Observations on the winter activities of desert reptiles. Ecology, 22: 125–140, pls. 1–5.

——, and C. M. Bogert. 1944. A preliminary study of the thermal requirements of desert reptiles. Bull. Amer. Mus. Nat. Hist., 83: 263–296, pls. 19–29, figs. 1–3.

Ellis, T. K. 1940. Notes on behavior of *Anolis*. Copeia, no. 3, pp. 162–164, figs. 1–3.

Evans, Llewellyn Thomas. 1935. Winter mating and fighting behavior of *Anolis carolinensis* as induced by pituitary injections. Copeia, no. 1, pp. 3–6.

Fisher, Edna M. 1934. Color in *Anniella nigra* Fischer. Copeia, no. 1, pp. 47–49, tables 1–4

——. 1936. Some observations on *Xantusia vigilis* Baird. Copeia, no. 3, pp. 172–176, figs. 1–2.

Fitch, Henry S. 1940. A field study of the growth and behavior of the fence lizard Univ. Calif. Publ. Zool., 44: 151–172.

Franklin, Dwight. 1914. Notes on leopard lizards. Copeia, no. 5, pp. 1–2.

Gander, Frank F. 1931. Observations on an alligator lizard. Copeia, no. 1, pp. 14–15.

Gilmore, Charles W. 1942. Osteology of *Polyglyphanodon*, an Upper Cretaceous lizard from Utah. Proc. U.S. Nat. Mus., 92: 229–265, pls. 24–26, figs. 16–30.

Girard, Charles. 1858. United States exploring expedition, during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N. Vol. XX. Herpetology. Philadelphia, J. B. Lippincott and Co., pp. i–xviii, 1–496.

Gloyd, H. K. 1938. Methods of preserving and labeling amphibians and reptiles for scientific study. Turtox News, 16: 49–53, 66–67, figs. 1–5.

Hanley, George H. 1943. Terrarium notes on California reptiles. Copeia, no. 3, pp. 145–147.

Herter, K. 1941. Die Vorzungstemperaturen bei Landtieren. Naturwissenschaften, 29: 155–164.

Hyman, Libbie H. 1942. Comparative vertebrate anatomy. Chicago, Univ. Chicago Press, pp. i–xx, 1–554, figs. 1–136.

Jopson, Harry G. M. 1938. Observation of the survival value of the character of the blue tail in *Eumeces*. Copeia, no. 2, p. 90.

Kauffeld, C. F. 1931. *Lacerta melisellensis fiumana* at Philadelphia. Copeia, no. 4, pp. 163–164.

Klauber, L. M. 1926. Field notes on *Xantusia henshawi*. Copeia, no. 152, pp. 115–117.

——. 1932. Notes on the silvery footless lizard, *Anniella pulchra*. Copeia, no. 1, pp. 4–6.

——. 1935. Notes on herpetological field collecting. Collecting Leaflet San Diego Soc. Nat. Hist., no. 1, pp. 1–10, figs. 1–4.

——. 1936. The horned toads of the *coronatum* group. Copeia, no. 2, pp. 103–110, figs. 1–2.

Kleinholz, L. H. 1938. Studies in reptilian colour change. II. The pituitary and adrenal glands in the regulation of the melanophores of *Anolis carolinensis*. Journ. Exp. Biol., 15: 474–491, pls. 1–4, figs. 1–3, tables 1–4.

——. 1938. Studies in reptilian colour change. III. Control of the light phase and behavior of isolated skin. Journ. Exp. Biol., 15: 492–499, pl. 1.

Knowlton, George F. 1932. The beet leafhopper in northern Utah. Utah Agri. Exp. Sta. Bull., no. 235, pp. 1–64, figs. 1–16.

——. 1934. Lizards as a factor in the control of range insects. Journ. Econ. Ent., 27: 998–1004.

——. 1936. Lizard digestion studies. Herpetologica, 1: 9–10.

——. 1937. Notes on three Utah lizards. Herpetologica, 1: 109–110.

——. 1942. Range lizards as insect predators. Journ. Econ. Ent., 35: 602.

——, and E. W. Anthon. 1935. *Uta stansburiana stansburiana* (Baird and Girard). Copeia, no. 4, p. 183.

——, W. Don Fronk, and D. R. Maddock. 1942. Seasonal food of the brown-shouldered *Uta* (lizard). Journ. Econ. Ent. 35: 942.

Knowlton, George F., and M. J. Janes. 1931. Notes on insect food of two Utah lizards. Utah Acad. Sci., 8: 140–142.

——, and M. J. Janes. 1932. Studies of the food habits of Utah lizards. Ohio Journ. Sci., 32: 467–470, figs. 1A–C.

——, and M. J. Janes. 1933. Lizards as predators of the beet leafhopper. Journ. Econ. Ent., 26: 1011–1016.

——, and M. J. Janes. 1934. Distributional and food habit notes on Utah lizards. Copeia, no. 1, pp. 10–14, fig. C.

——, and Clyde F. Smith. 1935. The desert gridiron-tailed lizard. Copeia, no. 2, pp. 102–103.

——, and W. L. Thomas. 1934. Insect food of trout-creek lizards. Proc. Utah Acad. Sci. Arts Lett., 12: 253–264.

——, and W. L. Thomas. 1934. Notes on some insectivorous Utah lizards. Proc. Utah Acad. Sci., Arts Lett., 11: 257–259.

——, and W. L. Thomas. 1936. Food habits of Skull Valley lizards. Copeia, no. 1, pp. 64–66.

Linsdale, Jean M. 1932. Amphibians and reptiles from Lower California. Univ. Calif. Publ. Zool., 38: 345–386.

Loeb, Leo. 1913. The venom of *Heloderma*. Carn. Inst. Wash. Publ., 177: iii–vi, 1–244, figs. 1–24.

Lowe, Charles H., Jr. 1943. Two broods of *Eumeces s. skiltonianus*. Copeia, no. 1, p. 58.

McCauley, Robert H., Jr. 1939. Differences in the young of *Eumeces fasciatus* and *Eumeces laticeps*. Copeia, no. 2, pp. 93–95.

McLain, Robert Baird. 1899. Critical notes on a collection of reptiles, from the western coast of the United States. Wheeling, W. Va., Privately Printed, pp. 1–13.

Miller, Charles M. 1943. An intergradient population connecting *Anniella pulchra pulchra* and *Anniella pulchra nigra*. Copeia, no. 1, pp. 2–6, fig. 1.

——. 1944. Ecologic relations and adaptations of the limbless lizards of the genus *Anniella*. Ecol. Mon., 14: 271–289, figs. 1–14.

Milne, Lorus J. 1938. Mating of *Phrynosoma cornutum*. Copeia, no. 4, pp. 200–201.

Mosauer, Walter. 1932. Adaptive convergence in the sand reptiles of the Sahara and of California; a study in structure and behavior. Copeia, no. 2, pp. 72–78, figs. 1–2.

——. 1936. The tolerance of solar heat in desert reptiles. Ecology, 17: 56–66, figs. 1–4

Newman, H. H., and J. Thos. Patterson. 1909. Field studies of the behavior of the lizard *Sceloporus spinosus floridanus*. Bull. Univ. Texas Sci. Ser., 15: 1–24, figs. 1–13.

Noble, G. Kingsley. 1934. Experimenting with the courtship of lizards. Nat. Hist., 34: 1–15, ill.

——, and H. T. Bradley. 1933. The mating behavior of lizards; its bearing on the theory of sexual selection. Ann. N.Y. Acad. Sci., 35: 25–100, figs. 1–12.

——. 1933. The effect of temperature on the scale form of regenerated lizard skin. Journ. Exp. Zool., 65: 1–16, figs. 1–7.

——, and K. F. Kumpf. 1936. The function of Jacobson's organ in lizards. Journ. Genetic Psych., 48: 371–382.

——, and E. R. Mason. 1933. Experiments on the brooding habits of the lizards *Eumeces* and *Ophisaurus*. Amer. Mus. Nov., no. 619, pp. 1–29.
Oliver, James A. 1943. The status of *Uta ornata lateralis* Boulenger. Copeia, no. 2, pp. 97–107, fig. 1.
Pack, Herbert J. 1918. Some habits of the pigmy horned toad. Copeia, no. 63, pp. 91–92.
——. 1921. Food habits of *Sceloporus graciosus graciosus* (Baird and Girard). Proc. Biol. Soc. Wash., 34: 63–66.
——. 1922. Food habits of *Crotaphytus wislizenii* Baird and Girard. Proc. Biol. Soc. Wash., 35: 1–4.
——. 1923. Food habits of *Callisaurus ventralis ventralis* (Hallowell). Proc. Biol. Soc. Wash., 36: 79–82.
——. 1923. The food habits of *Cnemidophorus tesselatus tesselatus* (Say). Proc. Biol. Soc. Wash., 36: 85–90.
Parker, G. H. 1938. The color changes in lizards, particularly in *Phrynosoma*. Journ. Exp. Biol., 15: 48–73, pls. 1–2.
——. 1943. Animal color changes and their neurohumors. Quart. Rev. Biol., 18: 205–227, figs. 1–9, tables 1–2.
Parker, H. W. 1935. A new melanic lizard from Transjordania, and some speculations concerning melanism. Proc. Zool. Soc. Lond., 1935, pp. 137–142, pl. 1.
Parker, T. Jeffery, and William A. Haswell. 1940. A textbook of zoology. Vol. II. Chordata. London, Macmillan and Co., pp. i–xxiii, 1–758, figs. 1–656.
Pritchett, Annie H. 1903. Some experiments in feeding lizards with protectively colored insects. Biol. Bull., 5: 271–287.
Redfield, Alfred C. 1918. The physiology of the melanophores of the horned toad *Phrynosoma*. Journ. Exp. Zool., 26: 275–333, pls. 1–5, figs. A–H.
Rodgers, Thomas L. 1939. A lizard live-trap. Copeia, no. 1, p. 51, fig. 1.
——, and Viola H. Memmler. 1943. Growth in the western blue-tailed skink. Trans. San Diego Soc. Nat. Hist., 10: 61–68, fig. 1.
Rüthling, Paul D. R. 1917. Some feeding habits of the desert rough-scaled swift. Lorquinia, 2: 9–11.
Ruthven, Alexander G., and L. C. Stuart. 1932. Notes on the period of post-depositional development in several common lizards. Occ. Pap. Mus. Zool. Univ. Mich., no. 241, pp. 1–3.
Salt, G. W. 1943. The lungs and inflation mechanism of *Sauromalus obesus*. Copeia, no. 3, p. 193.
Schmidt, Karl P. 1922. The amphibians and reptiles of Lower California and the neighboring islands. Amer. Mus. Nat. Hist. Bull., 46: 607–707, pls. 47–57, figs. 1–13.
——. 1925. The hoop snake story with some theories of its origin. Nat. Hist., 25: 76–80.
——. 1929. The truth about snake stories. Field Mus. Nat. Hist. Zool. Leaflet, no. 10, pp. 1–19.
Shaw, Charles E. 1943. Hatching of the eggs of the San Diego alligator lizard. Copeia, no. 3, p. 194.
Slevin, Joseph R. 1927. The making of a scientific collection of reptiles and amphibians. Proc. Calif. Acad. Sci., 4th ser., 16, 231–259, pls. 15–16.

Smith, Clarence F. 1941. Birth of horned toads. Copeia, no. 2, p. 114.
Smith, Hobart M. 1935. Miscellaneous notes on Mexican lizards. Kans. Univ. Sci. Bull., 22: 119–155, pls. 23–25.
——. 1935. Notes on some Mexican lizards of the genus *Holbrookia*, with the description of a new species. Univ. Kans. Sci. Bull., 22: 185–201, pls. 27–28.
——. 1942. Mexican herpetological miscellany. Proc. U.S. Nat. Mus., 92: 349–395, pl. 37, fig. 38, tables 1–2.
——. 1942. A new name for a United States skink. Proc. New Engl. Zool. Club, 21: 93–95.
Smith, Malcolm. 1933. Remarks on some Old World geckos. Records Indian Mus., 1933, pp. 9–19, ill.
——. 1935. The fauna of British India, including Ceylon and Burma. Reptilia and amphibia. Vol. II. Sauria. London, Taylor and Francis, pp. i–xiv, 1–440, pl. 1, map.
——. 1937. A review of the genus *Lygosoma* (Scincidae: Reptilia) and its allies. Rec. Indian Museum, 39: 213–234, figs. 1–5.
Stebbins, Robert C. 1943. Adaptations in the nasal passages for sand burrowing in the saurian genus *Uma*. Amer. Nat., 77: 38–52, pls. 1–2, figs. 1–2.
——. 1944. Some aspects of the ecology of the iguanid genus Uma. Ecol. Mon., 14: 311–332, figs. 1–22.
Stejneger, Leonhard. 1890. Annotated list of reptiles and batrachians collected by Dr. C. Hart Merriam and Vernon Bailey on the San Francisco Mountain Plateau and desert of the Little Colorado, Arizona, with descriptions of new species. N. Amer. Fauna, no. 3, pp. i–vii, 1–136, frontis., pls. 1–13, maps 1–5.
——. 1890. On the North American lizards of the genus *Barissia* of Gray. Proc. U.S. Nat. Mus., 13: 183–185.
——. 1900. Diagnosis of a new species of iguanoid lizard from Green Cay, Bahama Islands. Proc. U.S. Nat. Mus., 23: 471.
——. 1906. A new lizard of the genus *Phrynosoma*, from Mexico. Proc. U.S. Nat. Mus., 29: 565–567.
Storer, Tracy I. 1931. Heloderma poisoning in man. Bull. Antiv. Inst., 5: 12–15.
Stuart, L. C. 1940. Notes on the "Lampropholis" group of Middle American *Lygosoma* (Scincidae) with descriptions of two new forms. Occ. Pap. Mus. Zool. Univ. Mich., no. 421, pp. 1–16, fig. 1.
Tanner, Vasco M. 1942. Notes on the birth and growth of horned lizards. Great Basin Nat., 3: 60.
Taylor, E. H. 1938. Notes on the herpetological fauna of the Mexican state of Sonora. Univ. Kans. Sci. Bull., 24: 475–503, pl. 43.
Tevis, Lloyd. 1944. Herpetological notes from Lower California. Copeia, no. 1, pp. 6–18, figs. 1–2.
Viaux, Frederic B. 1939. Monster of the desert. New Engl. Nat., no. 4, pp. 17–19, ill.
Vogt, William. 1941. A practical lizard trap. Copeia, no. 2, p. 115.
von Geldern, Charles E. 1919. Mechanism of the production of the throat-fan in the Florida chameleon, *Anolis carolinensis*. Proc. Calif. Acad. Sci., 4th ser., 9: 313–329, figs. 1–7.
Walls, Gordon L. 1942. The vertebrate eye and its adaptive radiation. Cranbrook Inst. Sci. Bull., no. 19, pp. xvi, 785, frontis., 1 pl., 197 figs.

Weese, A. O. 1919. Environmental reactions of *Phrynosoma*. Amer. Nat. 53: 33–54, pls. 1–2, map.
Wilde, W. S. 1938. The role of Jacobson's organ in the feeding reaction of the common garter snake. Journ. Exper. Zool., 77: 445–464.
Wilson, F. H. 1939. Preliminary experiments on the color changes of *Anolis carolinensis* (Cuvier). Amer. Nat., 73: 190–192.
——. 1940. Color changes in blindfolded anoles. Copeia, no. 3, pp. 151–153.
Wood, Sherwin F. 1933. A quantitative study of food in some brown-shouldered lizards. Copeia, no. 3, pp. 122–124.
——. 1936. Oviposition and embryos of some western lizards. Copeia, no. 1, pp. 69–70.
——. 1936. Courting behavior of some western lizards. Copeia, no. 3, p. 177.
Young, E. A. E. 1942. The cranial morphology of the Californian lizard, *Xantusia vigilis*. S. African Journ. Med. Sci., 7 (biol. suppl.): 19–32, 11 figs.

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